Using the Model 2216T Ethernet Switch

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Bay Networks

4401 Great America Parkway
Santa Clara, CA 95054

8 Federal Street
Billerica, MA 01821

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Preface

Welcome to the Model 2216T Ethernet Switch. This switch features sixteen 10BASE-T ports and a 100BASE-X uplink port. Network performance can be dramatically improved when a workgroup switch is used to segment 10BASE-T hubs and provide a high-capacity 100 megabit per second (Mb/s) connection to a server or network center.

Purpose

This guide provides information about the features and capabilities of the Model 2216T switch and includes instructions for installing the switch and setting it up for network management.

Audience

This guide is intended for Ethernet local area network administrators with the following background:

- Working knowledge of Ethernet local area networks (LANs)
- Bay Networks® network experience (helpful but not required)
- Familiarity with Transmission Control Protocol/Internet Protocol (TCP/IP) and Simple Network Management Protocol (SNMP)

Conventions

This section describes the conventions used in this guide.

Special Message Formats

This guide uses the following formats to highlight special messages:

Note: This format is used to highlight information of importance or special interest.

Caution: This format is used to highlight information that will help you prevent equipment failure or loss of data.

Warning: This format is used to highlight information regarding the possibility of injury or equipment damage.

Two-tiered Procedure Format

The procedural steps in this guide are presented in a two-tiered format. The first tier (numbered steps) describes the step briefly but precisely. An experienced user may need to read only the first tier to complete the task. The second tier (lettered steps) describes the step in more detail and may include results of performing the step.

Use of Enter, Type, and Press

This guide uses “enter,” “type,” and “press” to describe the following actions:

- When you read “enter,” type the text and press the Enter key.
- When you read “type,” type the text, but do not press the Enter key.
- When you read “press,” press only the alphanumeric or named key.

Other Conventions

This guide uses the following typographical conventions:

italics	Book titles and UNIX file, command, and directory names.
`courier font`	Screen text, user-typed command-line entries.
Initial Caps	Menu titles and window and button names.
[Enter]	Named keys in text are shown enclosed in square brackets. The notation [Enter] is used for the Enter key and the Return key.
[Ctrl]+C	Two or more keys that must be pressed simultaneously are shown in text linked with a plus (+) sign.
ALL CAPS	DOS file and directory names.

Related Publications

For more information about using the Model 2216T switch, refer to the following publications:

- *Bay Networks Guide to Understanding 100BASE-T*
  (Bay Networks part number 345A-1105-BK)

  Discusses similarities between 100 Mb/s Fast Ethernet and 10BASE-T specifications. Offers cabling information and planning advice for adding 100BASE-T to existing 10BASE-T networks.

- *Technical Reference Pocket Guide*
  (Bay Networks part number BR345-1298US-C)

  Provides planning, installation, troubleshooting, and conceptual information about Bay Networks products.

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Europe	(33) 92-968-300	(33) 92-968-301
Asia/Pacific	(612) 9927-8800	(612) 9927-8811
Latin America	(407) 997-1713	(407) 997-1714

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- Customize the listing of cases according to a variety of criteria, including date, severity, status, and case ID.
- Log notes to existing open cases.
- Create new cases for rapid, efficient handling of noncritical network situations.
- Communicate directly via email with the specific technical resources assigned to your case.

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Customer Service FTP

Accessible via URL *ftp://support.baynetworks.com* (134.177.3.26), this site combines and organizes support files and documentation from across the Bay Networks product suite, including switching products from our Centillion™ and Xylogics® business units. Central management and sponsorship of this FTP site lets you quickly locate information on any of your Bay Networks products.

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The Support Source℠ CD contains extracts from our problem-tracking database; information from the Bay Networks Forum on CompuServe; comprehensive technical documentation, such as Customer Support Bulletins, Release Notes, and software patches and fixes; and complete information on all Bay Networks Service programs.

You can run a single version on Macintosh Windows 3.1, Windows 95, Windows NT, DOS, or UNIX computing platforms. A Web links feature enables you to go directly from the CD to various Bay Networks Web pages.

CompuServe

For assistance with noncritical network support issues, Bay Networks Information Services maintains an active forum on CompuServe, a global bulletin-board system. This forum provides file services, technology conferences, and a message section to get assistance from other users.

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Bay Networks recommends the use of CompuServe Information Manager software to access these Bay Networks Information Services resources. To open an account and receive a local dial-up number in the United States, call CompuServe at 1-800-524-3388. Outside the United States, call 1-614-529-1349 or your nearest CompuServe office. Ask for Representative No. 591. When you are online with your CompuServe account, you can reach us with the command **GO BAYNET**.

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To use InfoFACTS in the United States or Canada, call toll-free 1-800-786-3228. Outside North America, toll calls can be made to 1-408-764-1002. In Europe, toll-free numbers are also available for contacting both InfoFACTS and CompuServe. Please check our Web page for the listing in your country.

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Technical Response Center	Telephone Number	Fax Number
Billerica, MA	1-800-2LANWAN	(508) 670-8765
Santa Clara, CA	1-800-2LANWAN	(408) 495-1188
Valbonne, France	(33) 92-968-968	(33) 92-966-998
Sydney, Australia	(612) 9927-8800	(612) 9927-8811
Tokyo, Japan	(81) 3-5402-0180	(81) 3-5402-0173

Express Technical Support from the North America TRC

When calling the Bay Networks North America TRC, use Express Routing Codes 140 and 144 to obtain express technical support for the Model 2216T switch. Entering the express code expedites your call through the menuing system and routes it directly to the support group that is best qualified to answer your technical questions about the Model 2216T switch.

Chapter 1
About the Model 2216T Ethernet Switch

The Model 2216T switch is implemented as a 16-port, IEEE 802.1d-compliant 10BASE-TX Ethernet switch. This switch provides store-and-forward bridging between all 10 megabit per second (Mb/s) 10BASE-T ports. An additional seventeenth port on the switch allows a high-speed 100BASE-TX connection to a server. Each port on the switch operates at full Ethernet wire speed with full address and frame filtering. The switch automatically learns addresses and maintains them in a dynamic address table for making forwarding decisions.

For network management, the Model 2216T switch includes a standards-compliant SNMP agent. This agent allows network management station applications to collect and present status and performance information about a switch and to perform configuration and control functions on the device.

In addition, you can manage the switch in band using the popular TCP/IP application Telnet. A serial console port allows out-of-band management using a standard VT100 or similar terminal.

This chapter provides the following information:

- Summary of operational features (see page 1-2)
- Physical description of the switch (see page 1-5)

Features

The Model 2216T switch has the following operational features:

- Seventeen switched ports:
  - — Sixteen switched, half-duplex 10BASE-T ports
  - — One switched, half/full-duplex 100BASE-TX port
- Transparent bridging with support for 1024 MAC addresses
- Store-and-forward switching
- IEEE 802.1d Spanning Tree Protocol support
- Static MAC or destination address filtering
- Port mirroring that allows you to monitor network traffic through a station port
- In-band and out-of-band interface options for configuration and management
- Industry-standard Trivial File Transfer Protocol (TFTP) for downloading new switching software
- Nonvolatile storage of operating parameters
- SNMP support
- Optivity support
- LEDs to indicate switch operating conditions

Transparent Bridging

The Model 2216T switch is fully compliant with IEEE 802.1d transparent bridging specifications. The switch automatically “learns” addresses and maintains an aggregate address table containing 1024 entries for learning, filtering, and forwarding. You can also provide static address entries and apply various frame forwarding options based on destination MAC addresses in the table. The address table and filtering options are accessed out of band through a connection to the console port or in band using Telnet.

Store-and-Forward Switching

The Model 2216T switch is a store-and-forward device. Each frame is copied into switch memory before being forwarded to another port. This method ensures that all forwarded frames conform to the standard Ethernet frame size and have a correct cyclic redundancy check (CRC) for data integrity. This switching method prevents bad frames from traversing the network and using up valuable network bandwidth.

To minimize the possibility of dropping frames on congested ports, the Model 2216T switch provides 2 megabytes (MB) of buffering, dynamically allocatable among all ports. This buffer space is used to queue packets for transmission on congested networks and represents an advantage over "cut-through" switching technology, which drops packets immediately when experiencing collisions.

Spanning Tree Protocol

The Model 2216T switch supports the IEEE 802.1d Spanning Tree Protocol, which allows redundant connections to be created between LAN segments for fault tolerance. You can create two or more physical paths through the switch between different segments, with the Spanning Tree Protocol choosing a single path at any given time and disabling all others. If the chosen path fails for any reason, a disabled alternative is activated, thereby maintaining the connection. This mechanism prevents network traffic from circulating in an endless loop formed by multiple connections to the same LAN segment.

The switch is shipped from the factory with spanning tree operation disabled. You can modify spanning tree operation through the out-of-band console interface or in band using SNMP or Telnet.

Port Mirroring

A port mirroring feature in the switch allows the traffic transmitted and received on a specific 10BASE-T port to be copied to a mirror port (port 1), to which you can attach a LAN analyzer or RMON probe. You can leave the analyzer or probe permanently connected to the mirror port and steer it to monitor any of the remaining 15 10BASE-T ports or segments. Port mirroring for the 100BASE-T port is not supported.

You enable the port mirroring feature through the console port. When this feature is enabled, the port 1 LED blinks a number of times to indicate the number of the port that it is currently mirroring.

Software Download

The Model 2216T switch supports the industry-standard Trivial File Transfer Protocol (TFTP) for downloading switch software to the unit. All switch software is stored in a 512 kilobyte (KB) sectored flash ROM. This feature allows you to easily install upgrades and make changes to the unit.

The downloader software is invoked in one of the following ways:

- Out of band, using the switch serial console interface (See Chapter 5, "Downloading Software.")
- In band, using Telnet (See "Using the Telnet Interface for Management" on page 4-18.)

Nonvolatile Parameter Storage

Important operating parameters, such as IP addresses, spanning tree configuration, and management security parameters, are stored in nonvolatile flash memory and retain their values when the switch unit experiences power interruptions or is powered down for normal maintenance.

Configuration and Management Interfaces

The switch provides the following three interface types for management and configuration:

- Serial console port, out of band

  An RS-232 connection using a DB-9 connector allows you to connect a VT100 terminal or PC system running a terminal application such as Procomm Plus or Windows Terminal. For more information on managing the switch out of band, see Chapter 4, "Configuring and Operating the Switch," and Appendix D, "Menus and Commands."

- Telnet, in band (over Ethernet)

  The switch supports management through a Telnet connection using the TCP/IP protocols. The user interface is based on an ANSI terminal, and the menus are the same as the menus accessed through the out-of-band serial console attachment. See "Using the Telnet Interface for Management" on page 4-18 for more information about managing the switch using Telnet.

- SNMP-based network manager, in band

  The switch can be managed using the Simple Network Management Protocol (SNMP). Standard agent MIBs embedded in the switch provide basic SNMP management through industry-standard SNMP applications.

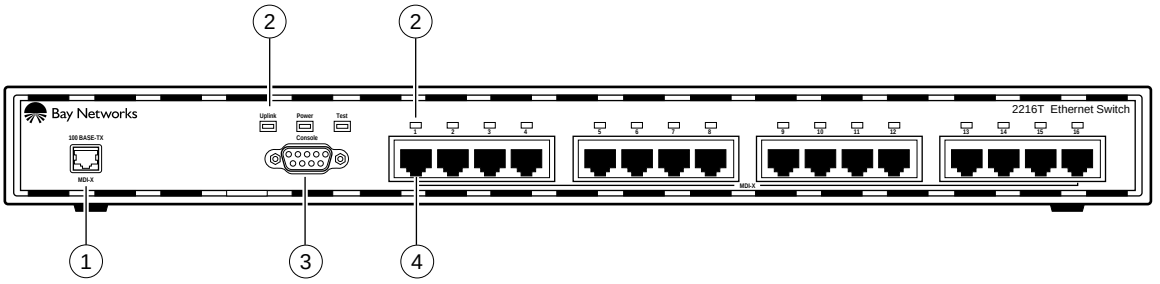
  Two levels of management security protection based on community names are provided. The SNMP public community allows you only to read objects, whereas the SNMP private community allows you to read and modify objects. See Chapter 4, "Configuring and Operating the Switch," for more detailed information about SNMP management.

Physical Description

The Model 2216T switch is a desktop or rack-mountable switch that provides 16 switched 10 Mb/s ports and one switched 100BASE-TX RJ-45 uplink port. LEDs on the front panel provide information about the operating status of the switch. The back panel of the switch contains the power entry connector and power switch. A fan maintains ventilation and cooling for switch internal components.

Front Panel

Figure 1-1 shows the front panel of the Model 2216T switch.The front panel includes the 100BASE-TX port, LEDs, console port, and 10BASE-T ports.



Key:
1 = 100BASE-TX port
2 = LEDs
3 = Console port
4 = 10BASE-T ports

Figure 1-1. Front panel of the Model 2216T Ethernet Switch

100BASE-TX Port

A single RJ-45 connector, labeled 100BASE-TX, provides connection to an optional 100BASE-TX Fast Ethernet network segment or end station. This UTP port is wired as an MDI-X connection. By default, this port operates in half-duplex mode. You can set the port for full-duplex operation to connect it to full-duplex-capable devices.

Workstations or servers with MDI connections can be connected directly to this port using an EIA/TIA-standard Category 5 straight-through cable. To connect a hub or other device with an MDI-X port to this port, you must use a Category 5 crossover cable. For connector pin assignments and cable specifications, see Appendix A, “Technical Specifications.”

LEDs

LEDs on the front panel of the switch indicate operational and diagnostic status for the switch (see Figure 1-2).

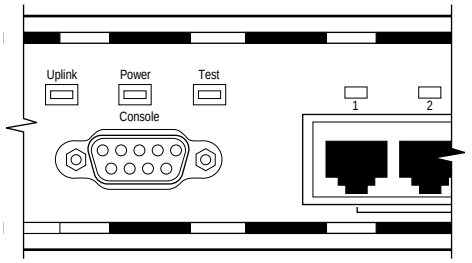


Figure 1-2. LEDs on the Model 2216T switch

For details about the operation of these LEDs, see Appendix B, "LEDs."

Console Port

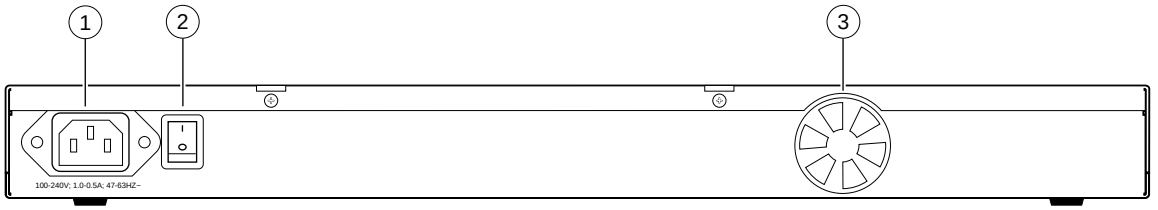
The console port is an RS-232 port implemented on a DB-9 male connector. This port is wired as a data communication equipment (DCE) port and requires a straight-through serial cable. Only three pins are used for transmit, receive, and signal ground. For cable specifications, see Appendix A, "Technical Specifications."

10BASE-TX Ports

Sixteen RJ-45 connectors, designated port 1 through port 16, provide connection to 10BASE-TX Ethernet network segments. The ports are wired as half-duplex, MDI-X connections. Workstations or servers with MDI connections can be connected to the switch using standard straight-through unshielded twisted-pair (UTP) cables. To connect a hub or other device with an MDI-X port to these ports, you must use a crossover cable. For connector pin assignments, see Appendix A, "Technical Specifications."

Back Panel

The back panel on the Model 2216T switch contains the power connector, power switch, and fan outlet (see Figure 1-3).



Key:
1 = Power connector
2 = Power switch
3 = Fan outlet

Figure 1-3. Back panel of the Model 2216T switch

Power Connector

Use the power connector to provide AC power to the Model 2216T switch. For information about power requirements and power cords for use with the switch, see Appendix A, "Technical Specifications."

Power Switch

The power switch allows you to turn the power on and off to a Model 2216T Ethernet Switch without disconnecting the cord.

Fan Outlet

The fan in a Model 2216T switch draws air in through the front and sides of the switch and discharges it through the outlet at the back of the switch. When you install the switch, be sure to allow space at the back and sides for adequate airflow.

Chapter 2
Model 2216T Ethernet Switch Applications

This chapter provides information to help you plan a network that uses the Model 2216T switch. The chapter includes the following topics:

- Network connectivity guidelines (see this page)
- Examples of network configurations using the Model 2216T switch (see page 2-2)

Network Connectivity Guidelines

This section discusses cabling and port requirements that you should be aware of before installing a Model 2216T switch.

Cable Length

When you connect devices to a Model 2216T switch, follow the cable length specifications listed in Table 2-1.

Table 2-1. Cable lengths for the Model 2216T switch

Port type	Cable type	Maximum segment length
10BASE-T	Category 3 or 5 UTP	100 meters
100BASE-TX	Category 5 UTP	100 meters

Connecting to Ethernet Hubs and Network Devices

When you connect the Model 2216T switch to another Ethernet switch or an Ethernet hub, remember that all the UTP ports are configured as MDI-X connections. Follow these guidelines for connecting the ports:

- Personal computers (PCs) and servers typically have network interface controllers (NICs) that are configured as MDI connections. To connect these devices, use a straight-through cable.
- Hubs and other switches typically have connectors that are configured as MDI-X. To connect these devices, use a crossover cable, unless they have MDI ports.

For more information about MDI-X ports, see Appendix A, “Technical Specifications.”

Network Configuration Examples

The Model 2216T switch is well suited for two types of switching application:

- Desktop switching for up to 260 users in a network using 100 Mb/s switches
- Backbone connections to a 100 Mb/s switch

Client/Server Network

To improve workstation performance in a client/server environment, the Model 2216T Ethernet Switch can be configured to provide full 10 Mb/s Ethernet connections to individual workstations by connecting each to a dedicated switch port (see Figure 2-1). Then the server can be placed on the higher-bandwidth 100 Mb/s port to eliminate bottlenecks to that device.

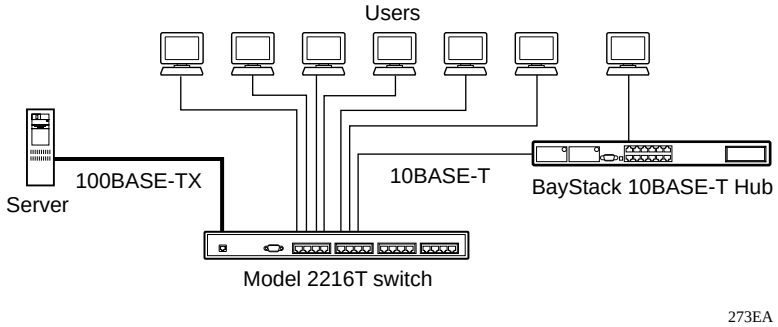


Figure 2-1. Model 2216T switch in a client/server network

Backbone Connections to a 100 Mb/s Switch

The Model 2216T switch can also be used in larger networks by connecting the 100BASE-TX port to a 100 Mb/s switch, such as the Model 28115 LattisSwitch Switching Hub (see Figure 2-2).

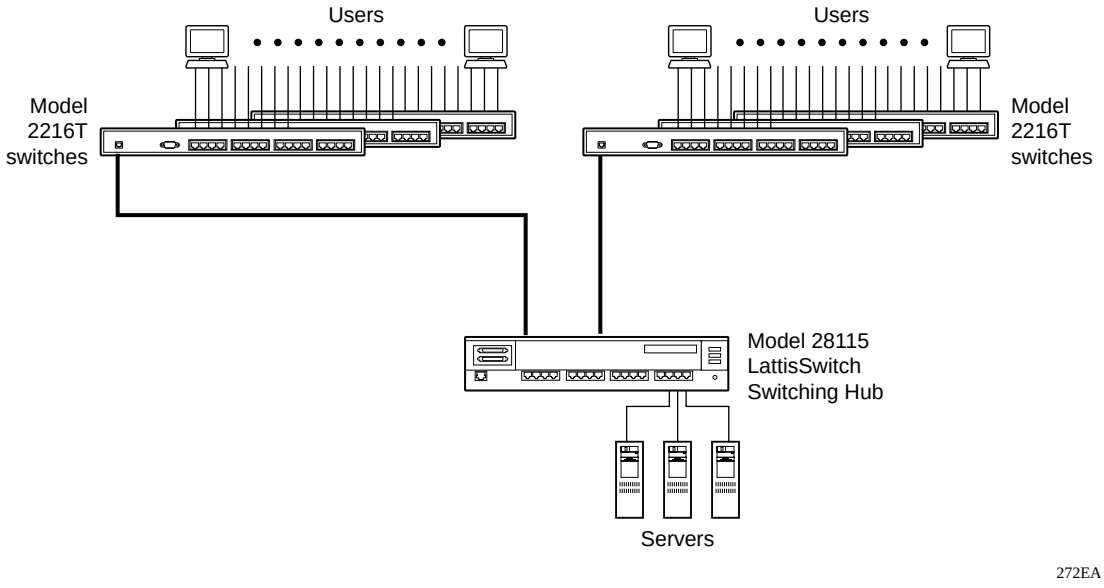


Figure 2-2. Backbone connections to a Model 2216T switch

Chapter 3
Installing the Switch

This chapter describes the physical installation of the Model 2216T switch. After a switch is installed, you can connect it to your network immediately and use the default operating parameters. The switch automatically learns network addresses and immediately begins switching network traffic.

You can also modify the switch configuration to meet your particular network requirements. Common items you may wish to configure include 100BASE-T half- or full-duplex operation, an IP address for Telnet and SNMP management, network management security features, and spanning tree parameters. If you decide to change the switch from its default settings, continue on to Chapter 4, "Configuring and Operating the Switch," after you complete the installation procedures described in this chapter.

This chapter includes information on the following topics:

- Preparing the installation site for the switch (see "Site Requirements" on page 3-2)
- Package contents (see "Unpacking the Switch" on page 3-3)
- Installing the switch on a table or in a rack (starting on page 3-3)
- Connecting power and verifying switch operation (starting on page 3-4)
- Connecting network cables (starting on page 3-8)

Site Requirements

Before you install the switch, make sure the installation site meets the following requirements:

- Equipment rack (optional)

  Use an EIA standard equipment rack that is grounded and mechanically stable. Allow one rack-mount space for each Model 2216T switch.

- Power source

  Within six feet of the installation location, you must have a power source that provides 100 VAC to 240 VAC and 50 Hz to 60 Hz, with a 100 VA maximum. For power specifications for the switch, see Appendix A, "Technical Specifications."

  Primary voltage selection within the above ranges is automatic with no user action required.

- Power cord

  If you are not using the cord that was shipped with the switch, make sure you use a cord with a grounding path. Without a proper ground, a person touching the unit is in danger of receiving an electrical shock. Lack of a grounding path to the unit may result in excessive conducted or radiated emissions.

- Environmental requirements

  Install the Model 2216T switch in a dry area, with adequate air circulation. Avoid placing the switch in direct sunlight or near other heat sources, such as hot-air vents. For temperature and humidity specifications, see Appendix A, "Technical Specifications."

- Ventilation

  Do not restrict air flow by covering or obstructing air inlets on the sides of the case or the internal air fan exit at the back of the unit.

Unpacking the Switch

Carefully unpack the contents of the switch shipping carton. Before you install the unit, check the contents of the carton and make sure that you have the following items:

- Model 2216T switch
- Rack-mounting brackets and hardware
- *Using the Model 2216T Ethernet Switch* (this guide)
- Warranty card
- Power cord

The Model 2216T switch is shipped with a standard North American 3-pin power cord, which is UL (USA), CSA, or CUL (Canada) listed or approved. U.S. power cords must be UL recognized and CSA certified. UL must be stamped on the cord jacket, and a CSA label must be secured to the cord.

If you are installing the switch outside North America, use a cord that meets the electrical specifications in your area. For power cord specifications, see Appendix A, "Technical Specifications."

Installing the Switch on a Table or Shelf

To install the switch on a table or shelf, set the switch in place on a table or shelf that can support at least 10 pounds. Make sure there is adequate space around the switch for ventilation and cooling.

When you finish physically installing the switch, connect the power cord and verify switch operation, as described in "Connecting Power" on page 3-4.

Installing the Switch in a Rack

To install the switch in an equipment rack, follow these steps:

1. **Attach the rack-mounting brackets (see Figure 3-1).**
2. **Slide the switch into the rack.**

3. **Insert and tighten the rack-mounting screws (see Figure 3-1).**

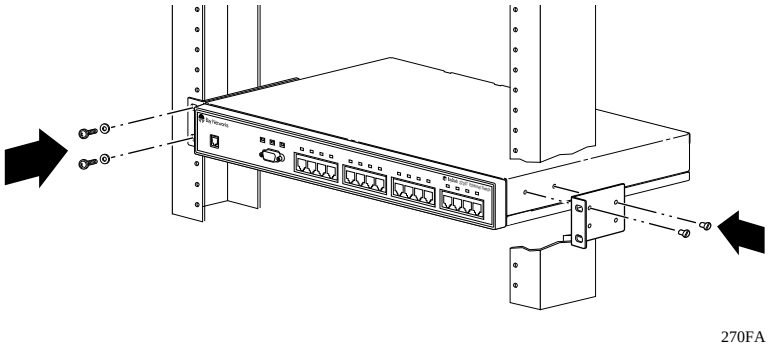


Figure 3-1. Installing the switch in a rack

When you finish physically installing the switch, connect the power cord and verify switch operation, as described in the next two sections.

If you connect a terminal to the console port, you can observe the progress and results of the power-up diagnostics as the switch goes through the power-up sequence. For instructions on connecting a terminal, see Chapter 4, "Configuring and Operating the Switch."

Connecting Power

To complete the installation of the switch, follow these steps:

1. **Connect the power cable to the switch and to a grounded 3-prong wall outlet (see Figure 3-2).**

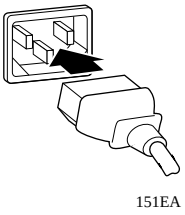
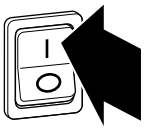


Figure 3-2. Connecting the power cord to the switch

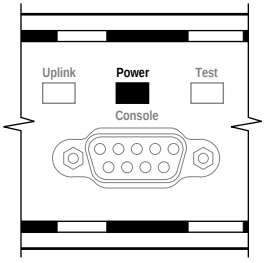
2. **Turn on the power switch (see Figure 3-3).**



152FA

Figure 3-3. Turning on the power

The Power LED lights green (see Figure 3-4). If it does not, check to make sure that the power cable is plugged in correctly and that the power source is good.



153EA

Figure 3-4. Power LED

Verifying Operation

When you turn the power on, the switch performs a series of hardware and system tests to verify the correct operation of the unit. If a terminal or computer is connected to the console port, the results of the tests are displayed on the screen. If you want to display the results of the self-tests after the switch has been turned on, cycle power by turning the power switch off and back on.

The switch performs the following two types of test:

- Serial port test

  The serial port (console port) test is the first test performed. If the switch passes this test, text begins displaying on the terminal describing the results of the self-tests.

If the switch fails this test, the Test LED lights (see Figure 3-5), no further tests are performed, and the terminal remains blank.

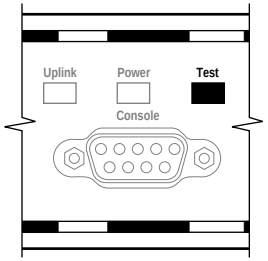


Figure 3-5. Test LED

- Memory tests

  The switch performs a set of memory tests after the serial port test. As the tests are executed, various messages are displayed on the terminal (see Figure 3-6) and the Test LED lights green. If the switch passes all the tests, the Test LED goes off and the switch goes into normal switching mode.

```
Read 9600 baud rate
Private Memory Test
  Byte Test
  Short Test
  Burst Test
  PRB Test
  Shared Memory Test
  Burst Test
  PRB Test




8Port Switch Boot Code. SW Version xx.xx

 ........ flash check_sum 17AB209
 ........ calc checksum 17AB209
 ...Memory Tests Over
```

Figure 3-6. Memory tests

The switch continues to execute memory tests even if some of them fail; the Test LED remains on to indicate failed tests. When all tests are completed, a screen message informs you that the memory tests failed, and the results of the test and the possible location (data or address lines) of the failure are displayed on the terminal (see Figure 3-7). Write down the results of the test and call Bay Networks Customer Support.

For more detailed testing of the switch, you can enable extended Ethernet interface diagnostics through the serial console interface. Because the extended diagnostics require a significant amount of time for completion, the switch is shipped with these tests disabled. For instructions on running the extended diagnostics, see "Setting Advanced Options" on page 4-9.

```
BOARD TYPE:a Checking for terminator plug
Starting fast ethernet diags
LCA made Fri Jun 07 14:11:43 1996
100BaseT card initialized
Fast Ether: resetting port 1

Port 1 is Ethernet MACE id = 3940 PAD test = 0 LADR test = 0
Port 2 is Ethernet MACE id = 3940 PAD test = 0 LADR test = 0
Port 3 is Ethernet MACE id = 3940 PAD test = 0 LADR test = 0
.
.
.
Port 15 is Ethernet MACE id = 3940 PAD test = 0 LADR test = 0
Port 16 is Ethernet MACE id = 3940 PAD test = 0 LADR test = 0
16 Num Ethernet located
Ethernet 0 diags OK
Ethernet 1 diags OK
Ethernet 2 diags OK
Ethernet 3 diags OK
.
.
.
Ethernet 12 diags OK Fast Ether: resetting port 13
Fast Ether: enabling tx only for port 13
ETH: disabling rx for eth 1
```

Figure 3-7. Memory test results

If the switch passes all memory tests, the Test LED turns off and a screen message indicates that the memory tests have passed and that the operating software, with all user-defined parameters, is loading into memory. This process may take several seconds.

When the switch has successfully completed its self-tests, you can connect the network cables, as described in "Connecting Network Cables" next in this chapter.

Connecting Network Cables

You can connect network devices to the Model 2216T Ethernet Switch using the following two types of cable:

- Category 3 UTP for connecting ports 1 through 16
- Category 5 UTP for connecting ports 1 through 16 or the 100BASE-TX uplink port on the switch

Note: The RJ-45 ports on the switch are configured as MDI-X connections. If you are connecting these ports to an MDI port (commonly found on PCs or servers), use a straight-through cable. If you are connecting these ports to another MDI-X port (commonly found on switches or hubs), use a crossover cable.

To connect network cables, follow these steps:

1. **Using Category 3 or 5 UTP cable, connect any of the port 1 through port 16 RJ-45 connectors to servers, workstations, hubs, and other devices as required in your network (see Figure 3-8).**

   The green LED above each properly connected active port lights green.

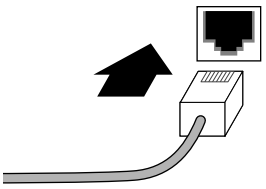


Figure 3-8. Connecting an RJ-45 port on the switch

2. **Using Category 5 UTP cable, connect the 100BASE-TX RJ-45 connector to a 100BASE-TX end station or network segment, if required (see Figure 3-8).**

   The Uplink LED on the front of the switch lights green with traffic on the port.

The Model 2216T switch is now switching traffic between all actively connected ports, acting as a 16-port transparent bridge. It automatically learns the addresses of all end stations communicating through each port and appropriately directs traffic between the ports. The switch can function with no changes to the factory default settings. (For a list of factory default settings, see Chapter 4, "Configuring and Operating the Switch.")

If you need to modify the switch operation (for example, to set an IP address for network management or to configure spanning tree features), you must connect the console port. For instructions on how to connect this port, see "Connecting a Terminal to the Console Port" on page 4-2.

Caution: The factory default settings of the switch do not include password protection. The default access rights are set to READ/WRITE. To prevent unauthorized changes to the configuration, set a password as described in "Setting Password Protection" on page 4-6.

Chapter 4
Configuring and Operating the Switch

When the physical installation of the Model 2216T switch is completed, it begins operating with its factory default configuration. However, the switch provides a series of console port menus that allow you to customize switch operating parameters for your particular network and to monitor switch operation. You can set security features, establish address handling conditions, and enable or disable ports through the console interface. In addition, to manage the switch or access the switch through Telnet, you must use the console menus to set certain parameters, such as the IP address for the switch.

This chapter provides information about the following topics:

- Using factory default settings (see this page)
- Connecting to the console port (see page 4-2)
- Setting up and monitoring the switch (see page 4-5)
- Using the Telnet interface for management (see page 4-18)

Using Factory Default Settings

When you turn on power to the switch, it begins operation using default settings for configuration parameters. Table 4-1 lists default values for the parameters.

Table 4-1. Factory default settings

Parameter	Default value
Password	NONE
Broadcast Cutoff Rate	100000
Terminal Baud Rate	9600

Table 4-1. Factory default settings (continued)

Parameter	Default value
Bypass Extended Diagnostics	YES
Port Mirroring Enabled	NO
Port Number to Be Mirrored	2
Path Cost	100
Port Priority	128
Half or Full Duplex	Half Duplex
Active Aging Time	300
Purge Aging Time	620
Spanning Tree Protocol	OFF
Hello Time	2
Forward Delay	15
Max Age	20
Hold Time	1
Bridge Priority	32768

Connecting a Terminal to the Console Port

The serial console interface is an RS-232 port that enables a connection to a PC or VT100 terminal for monitoring and configuring the switch. You can also connect this port to an external modem to enable remote dial-in management of the switch. The port is implemented as a data communication equipment (DCE) connection, using a male DB-9 connector.

To use the console port, you need the following equipment:

- A VT100 terminal or TTY-compatible terminal, or a portable computer with a serial port and the ability to emulate a VT100 terminal

  The terminal should have the following settings:

  — 9600 baud

  — No parity

  — 8 bits

  — 1 stop bit

— Window Terminal Emulator option set to NO

— Terminal Preferences—Function, Arrow, and Control keys active

See Appendix C, "Sample Terminal Configurations," for a detailed description of the configuration parameters for the Windows 3.1 Terminal Program and Procomm Plus version 2.01 if you are using these programs on a PC.

- A UL-listed straight-through RS-232 cable with a female DB-9 connector for the console port on the switch

  The other end of the cable must have a connector appropriate to the serial port on your computer or terminal. (Most terminals or computers use a male DB-25 connector.)

  Any cable connected to the console port must be shielded to comply with emissions regulations and requirements. For cable specifications and connector pin assignments, see Appendix A, "Technical Specifications."

To connect a terminal to the console port, follow these steps:

1. **Set the terminal protocol as described previously.**
2. **Connect the terminal (or a computer in terminal-emulation mode) to the console port using the RS-232 cable.**
   a. **Connect the female connector of the RS-232 cable directly to the service port on the switch and tighten the captive retaining screws (see Figure 4-1).**

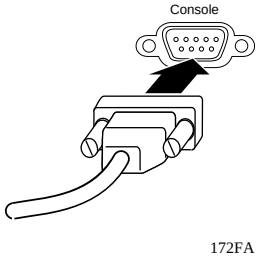


Figure 4-1. Connecting to the console port

   b. **Connect the other end of the cable to a VT100 terminal or the serial connector of a personal computer running communications software.**

3. **Turn on the terminal; adjust contrast and brightness as required.**
4. **If the switch power is already turned on, press [Esc] to display the Main Menu.**

You can now access the configuration menus to observe self-tests and to modify operating parameters for the switch.

Note: Do not use the console port simultaneously with in-band Telnet sessions.

When you turn on power to the switch, it goes through a set of power-up diagnostics while the Test LED lights green. If the switch passes all memory tests, the Test LED turns off and a screen message indicates that the memory tests have passed and that the operating software, with all user-defined parameters, is loading into memory. This process may take several seconds.

At successful completion of the initial boot sequence, the Main Menu is displayed (see Figure 4-2). To display the Main Menu after the switch has been in operation for a while, press [Esc].

```
Ethernet Switch 2216T                                SW version xx.xx
Access Control: READ/WRITE

      Main Menu

   >> System Configuration Menu
      Port Menu
      Switch Configuration Menu
      Switch Statistics Screen
      Download Software
      Reset
      Login
      Logout
      Set Password
      Clear Password
      Return To Default Configuration

Use UP or DOWN arrow to choose an item, <Enter> to select that item.
   CTRL-P to return to this menu.
   Display the System Configuration Menu.
```

Figure 4-2. Main Menu

Setting up and Monitoring the Switch

The switch console interface consists of a series of configuration menus that allow you to modify the default switch configuration, set up the switch for network management, and set network management security features. They also allow you to monitor the status and performance of the switch. See Appendix D, “Menus and Commands,” for an overview of menu hierarchy and descriptions of all menus.

The following sections describe common tasks in setting up and operating the Model 2216T switch. Although you can perform these tasks at any time while the network is in operation, they are described here in the order in which you would most likely perform them.

To begin with, set operating parameters and make sure the network connections are correct by performing these tasks:

- Set a password for the switch to prevent unauthorized access to switch menus.

- If you plan to manage the switch using SNMP, or if you will use Telnet to access the switch, assign an IP address for the switch.
- To verify that network connections are correct, check the Port Table menu.

After the switch is installed and operating, you may want to perform one of the following tasks:

- To troubleshoot switch operation, you can enable extended diagnostics or port mirroring using the Advanced Options menu (see "Setting Advanced Options" on page 4-9).
- To use advanced switch features, you can change spanning tree parameters or set address table parameters (see "Setting Switch Spanning Tree Parameters" on page 4-11 and "Setting Up the Address Table" on page 4-12).
- During network operation, you can monitor switch performance to evaluate the traffic patterns on the network or to troubleshoot a problem (see "Viewing Switch Statistics" on page 4-15 and "Viewing Port Statistics" on page 4-16).

Setting Password Protection

The switch is factory configured with access rights to the console interface set to READ/WRITE. This setting allows anyone to use the console menus to modify any operational parameter of the switch. To protect the configuration of the switch from unauthorized modification, you should enable password protection to the console interface.

To enter a password, follow these steps:

1. **Select Set Password from the Main Menu. Press [Enter].**
2. **Enter a password containing six to eight alphanumeric characters.**

   The password is not case sensitive.

   For verification, you are asked to enter your password again. If both entries agree, the new password is saved.

   If you change the password to NONE, the assigned password is deleted and the switch reverts to the factory default state.

After you enter a password and log out, all access rights change to READ ONLY. The current level of access control is indicated at the top of each menu.

If you ever forget or misplace your password, contact Bay Networks Customer Support.

Note: You are automatically logged off if the keyboard is idle for 15 minutes.

Assigning an IP Address

To assign an IP address to the switch, follow these steps:

1. **Select Switch Configuration Menu from the Main Menu.**

   The Switch Configuration menu is displayed similar to Figure 4-3.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Switch Configuration Menu


   >> Previous Menu
      Address Table Configuration Menu
      Spanning Tree Configuration Menu
      Authorized Manager Menu
      IP Address                    198.147.079.235
      Subnet Mask                   255.255.255.000
      Active Aging Time (Sec.)      300
      Purge Aging Time (Sec.)       620




  Use UP or DOWN arrow to choose an item, <Enter> to select that item.

Return to the previous menu.
```

Figure 4-3. Switch Configuration Menu

2. **Use the arrow key to select IP Address. Press [Enter].**

3. **Enter the IP address in dotted-decimal notation.**

   The IP address is now programmed for the switch. The subnet mask is automatically set to correspond to the class of the IP address you entered. If a different mask is used on the network, select Subnet Mask from the menu and enter the appropriate mask.

Checking Network Connection Status

To check connection status for the network, follow these steps:

1. **Select Port Menu from the Main Menu.**

   The Port Menu is displayed similar to Figure 4-4.

   If a network cable is properly connected to a port that is passing traffic, the status for the port reads LINK. If no cable is connected to a port, or if the cable or port is faulty, the status for the port reads NO LINK.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

     Port Menu

     Port#        Port Name           Type           Status
     1                                10BASE-T       NO LINK
     2          Accounting            10BASE-T       LINK
     3                                10BASE-T       NO LINK
     4          Engineering           10BASE-T       LINK
     5                                10BASE-T       NO LINK
     .          .                     .              .
     .          .                     .              .
     .          .                     .              .
     14                               10BASE-T       NO LINK
     15                               10BASE-T       NO LINK
     16         Sales                 10BASE-T       LINK

   >> 17        Server1              100B-T/FD      LINK

  Use UP or DOWN arrow to choose a port.

Right or Left arrow to choose, <Enter> to select, <Esc> to abort
>>Prev. Menu     Configure     View Statistics     Enable     Partition
```

Figure 4-4. Port Menu

2. **If you see NO LINK for a port that is connected, plug the cable into another port on the switch or try another cable.**

Setting Advanced Options

The Advanced Options Menu allows you to enable extended diagnostics and port mirroring for the switch. To set these features, follow these steps:

1. **Select System Configuration Menu from the Main Menu.**

   The System Configuration Menu is displayed similar to Figure 4-5.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

     System Configuration Menu

    >>Previous Menu
      Download Configuration
      Advanced Options Menu
      Serial Number                 12739
      System Name
      System Location
      System Contact
      SNMP Private Community Name   private
      SNMP Public Community Name    public
      Powerup Count                 9
      Broadcast Cutoff Rate         100000
      Gateway IP Address
      Terminal Baud Rate            9600



  Use UP or DOWN arrow to choose an item, <Enter> to select that item.

  Return to the previous menu.
```

Figure 4-5. System Configuration Menu

2. **Select Advanced Options Menu and press [Enter].**

   The Advanced Options Menu is displayed similar to Figure 4-6.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Advanced Options Menu

    >>Previous Menu
      Bypass Extended Diagnostics   YES
      Port Mirroring Enabled        NO
      Port Number To Be Mirrored    2









  Use UP or DOWN arrow to choose an item, <Enter> to select that item.

  Return to the previous menu.
```

Figure 4-6. Advanced Options Menu

3. **Use the up and down arrow keys to select the feature you want to enable and press [Enter].**
4. **Use the right and left arrow keys to select YES or NO and press [Enter].**

Note: To enable extended diagnostics for the switch, select NO for “Bypass Extended Diagnostics.”

5. **If you are enabling port mirroring, select “Port Number to Be Mirrored” and enter a port number 2 through 16 (port 1 is the port where the network traffic is mirrored).**

Setting Switch Spanning Tree Parameters

The Model 2216T switch is shipped with spanning tree operation disabled. To change spanning tree parameters, you must first set the Spanning Tree Protocol parameter to ON.

Before you change any settings for spanning tree parameters, read Appendix E, "Spanning Tree Concepts."

To set spanning tree parameters for the switch, follow these steps:

1. **Select Switch Configuration Menu from the Main Menu.**

   The Switch Configuration Menu is displayed (see Figure 4-3).

2. **Select Spanning Tree Configuration Menu and press [Enter].**

   The Spanning Tree Configuration Menu is displayed similar to Figure 4-7.

```
Ethernet Switch 2216T                          SW version xx.xx
Access Control: READ/WRITE

    Spanning Tree Configuration Menu

                              Configured Value      Current Value

  >>Previous Menu
    Spanning Tree Protocol    OFF
    Hello Time                2                     2
    Forward Delay             15                    15
    Max Age                   20                    20
    Hold Time                 1
    Bridge Priority           32768
    Bridge ID                                       8000-00C0BA037FB7
    Designated Root                                 8000-00C0BA037FB7
    Root Path Cost                                  0
    Root Port                                       NO PORT
    Topology Change Count                           0


UP or DOWN choose, <Enter> to select. (Note: All Times Are In Seconds)

Return to the previous menu.
```

Figure 4-7. Spanning Tree Configuration Menu

Two values are listed for each parameter in the table. The first column lists the current value for the parameter, and the second column confirms the new value when you press [Enter]. To enable the operation, select Spanning Tree Protocol and change the value to ON. You can change other values in the table as required.

Caution: You can cause serious network deterioration if you do not understand spanning tree concepts enough to configure the spanning tree parameters properly. Be very careful if you choose to turn on spanning tree operation.

Setting Up the Address Table

The switch address forwarding table is automatically created and maintained by the switch. It typically requires no configuration or modification. However, specific addresses may sometimes require certain treatment. For example, you can completely block addresses from access through the switch for security purposes.

To view and modify forwarding information, follow these steps:

1. **Select Switch Configuration Menu from the Main Menu.**

   The Switch Configuration Menu is displayed.

2. **Select Address Table Configuration Menu from the menu and press [Enter].**

   The Address Table Configuration Menu is displayed similar to Figure 4-8.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Address Table Configuration Menu

     Destination MAC Addr    Type      Disposition     Port #   Port Name

   >> 0000F4-111111          Static    Fwd To Port     7
      00C0BA-02C0BF          System    Local
      00C0BA-02C0C0          System    Local
      00C0BA-02C0C1          System    Local
      00C0BA-02C0C2          System    Local
      00C0BA-02C0C3          System    Local
      00C0BA-02C0C4          System    Local
      00C0BA-02C0C5          System    Local



  Use UP or DOWN arrow to choose an item

Right or Left arrow to choose, <Enter> to select, <Esc> to abort.
>>Prev. Menu     Add     Delete     Make Static     Modify     Pg Dwn
  Pg Up    First Pg     Last Pg      Search
```

Figure 4-8. Address Table Configuration Menu

This menu allows you to view and modify the current addresses in the forwarding table of the switch. Destination MAC addresses, along with forwarding information about them, are listed in a table format. The Type field can have the following values:

- Static—A table entry manually configured by the network manager that remains in the table indefinitely unless the network manager removes it.
- Dynamic—An entry in the table that was learned by the switch and that can be removed due to aging if the address is inactive on the network long enough. Dynamic entries are made Static by using the Make Static option.
- System—An entry for an address that is recognized to be destined for the switch itself. It is read in and processed by the switch. These entries cannot be changed.

The Disposition field indicates the type of action taken by the switch when a packet with the associated destination MAC address enters the switch. The destination port can be modified or filtered to ensure security, to reduce traffic, or to isolate segments of the network. This field can have the following values:

- Fwd To Port—The switch forwards the packet to the port number indicated in the Port # field.
- Discard—The switch discards the packet.
- Local—The switch processes the packet locally.
- Broadcast—The switch sends the packet to all ports in the switch.

3. **To modify the forwarding table, use the up and down arrow keys to select an address from the list. Then use the right and left arrow keys to select from the options at the bottom of the screen to add, delete, modify, or make static an entry in the table.**

   Select the Pg Dwn, Pg Up, First Pg, Last Pg, and Search options to move around in the table.

Setting SNMP Management Access

Access to the switch through SNMP is controlled by community names. The community names set for the switch must match those used by the SNMP management station for successful communication to occur. The switch uses two community names. The “Public” community name allows read-only access to the device via SNMP. The “Private” community name allows read/write access.

To set community names for the switch, follow these steps:

1. **Select System Configuration Menu from the Main Menu.**

   The System Configuration Menu is displayed.

2. **Select SNMP Private Community Name from the menu and enter the desired read/write access community name.**

3. **Select SNMP Public Community Name and enter the desired read-only access community name.**

When the access rights to the console are read only, the SNMP Public Community Name appears in the System Configuration Menu, but not the private name.

Viewing Switch Statistics

To view switch statistics, follow these steps:

1. **Select Switch Statistics Screen from the Main Menu.**

   The Switch Statistics Screen is displayed similar to Figure 4-9.
   These statistics represent cumulative counts for all ports on the switch.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

    Switch Statistics Screen

    Statistic Name                          Total (Frames)   Rate (Frames/Sec)

  >>Frames Received                         0                0
    Frames Filtered                         0                0
    Frames Forwarded                        0                0
    Frames Dropped                          0                0



Right or Left arrow to choose, <Enter> to select, <Esc> to abort.
>>Prev. menu      Clear These Statistics
```

Figure 4-9. Switch Statistics Screen

2. **To clear these statistics for the switch, use the right or left arrow keys to select Clear These Statistics and press [Enter].**

Viewing Port Statistics

To view port statistics, follow these steps:

1. **Select Port Menu from the Main Menu.**

   The Port Menu is displayed similar to Figure 4-10.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

Port Menu

   Port#          Port Name          Type             Status
     1                               10BASET          NO LINK
     2            Accounting         10BASET          LINK
     .
     .
     .
     14                              10BASET          NO LINK
     15                              10BASET          NO LINK
     16           Sales              10BASET          LINK

   >>17           Server1            100B-T/FD        LINK

 Right or Left arrow to choose, <Enter> to select, <Esc> to abort
>>Prev. menu      Configure     View Statistics     Enable     Partition
```

Figure 4-10. Port Menu

2. **Use the up and down arrow keys to select the port for which you want to view statistics. Then use the right or left arrow keys to select View Statistics. Press [Enter].**

   The Statistics for Port screen is displayed similar to Figure 4-11.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

       Statistics For Port 2: ACCOUNTING

       Statistic Name                                      Total (Frames)

       Frames Received                                     1708
       Bytes Received                                      413308
       Receive CRC Errors                                  0
       Receive Alignment Errors                            0
       Receive Lack of Resource Errors                     0
       Frames Transmitted                                  1464
       Bytes Transmitted                                   354288
       Transmit Multiple Collisions                        0
       Transmit Excessive Collision Errors                 0
       Transmit Carrier Loss Errors                        0
       Transmit Queue Excess Length Errors                 0
       Transmit Device Underrun Errors                     0

   Right or Left arrow to choose, <Enter> to select, <Esc> to abort.
   >>Prev. Screen      Clear These Statistics
```

Figure 4-11. Statistics for Port screen

3. **To clear the statistics for the port, use the right or left arrow keys to select Clear These Statistics and press [Enter].**

Using the Telnet Interface for Management

Telnet is a common terminal emulation application used in TCP/IP networks for remote terminal access to computer devices. You can use Telnet over an Ethernet network to remotely configure and monitor the Model 2216T switch. Up to two Telnet sessions can run concurrently.

Before you can access the switch over Telnet, you must assign an IP address to the switch as described on page 4-7. Then you can establish a Telnet connection to the switch. All the console menus are available through this connection, and you use the menus exactly as they are described in this chapter and in Appendix D, "Menus and Commands."

Note: If the Telnet connection is idle for 15 minutes, the connection is closed.

Chapter 5
Downloading Software

You can upgrade switching software in the Model 2216T switch without physically opening the unit. The storage sector for switching software in the flash memory of the switch is reprogrammable, allowing you to easily download software feature enhancements and problem fixes to the switch.

Downloading Software

You can download software to the switch in the following two ways:

- A direct serial download is an out-of-band operation that copies the software through the console port to the switch. This operation takes approximately 10 minutes but requires the least configuration.
- A TFTP download provides in-band remote download from a TFTP server over the network. A TFTP download is much faster than a serial download, requiring only a few seconds, and can be used to upgrade a switch that is not physically close. The disadvantage is that this method requires a TFTP server and more setup.

Direct Serial Download

A serial download is the easiest method to upgrade the switch software. This method is also the only kind of download you can perform if the flash memory is corrupted in the switch.

To perform a direct serial download, you need the following equipment:

- A personal computer (PC) with a 1.4 MB floppy drive

  The PC should be running a terminal-emulation program with xmodem capability, such as Procomm Plus, Windows Terminal Emulation, or Windows 95. For information about the configuration settings for these programs, see Appendix C, "Sample Terminal Configurations."

- A cable to connect the PC to the console port on the switch
- A diskette containing the upgrade software (available from your reseller or Bay Networks Customer Support)

To prepare for the serial download, follow these steps:

1. **Set the configuration settings for the terminal-emulation program on the PC.**
2. **Connect the PC to the console port on the switch, as described in "Connecting a Terminal to the Console Port" on page 4-2.**
3. **Press [Esc] to display the Main Menu.**

The first stage in performing a serial download is to access the downloader. To do so, follow these steps:

1. **Select Download Software from the Main Menu and press [Enter].**

   The following message appears on the screen:

   ```
   ARE YOU SURE YOU WANT TO ENTER THE DOWNLOADER?
   YES or NO
   ```

2. **Select YES to invoke the downloader and press [Enter].**

   (NO returns you to the Main Menu.)

   The switch begins a reset sequence, and the following message is displayed:

   ```
   Entering the Downloader
   ```

   After approximately 5 seconds, the following message is displayed and the Test LED flashes on and off:

   ```
   Trying to establish a download method...
   (Esc to abort)
   Attempting Both Serial and TFTP Downloads.
   ```

At this point, the switch is ready to receive the new software. You can stop the download process by pressing [Esc]. The download process stops, and the following message appears:

```
The download was aborted or failed.

Press Esc to reset the unit. Any other key to re-enter the
downloader.
```

If you press [Esc] again, the switch goes through a reset. If you press any other key, the switch reenters the downloader.

After you access the downloader, the next step is to copy the file to the serial port. The following example copies the software upgrade to the switch using Procomm Plus as a terminal emulator.

To copy the software upgrade to the switch, follow these steps:

1. **While the "attempting download" message is displayed on the screen, insert the upgrade disk into a drive (for example, drive A).**
2. **Press PgUp to access the Send File utility.**
3. **Press X for an XMODEM transfer.**
4. **At the Enter Filename prompt, enter a file name, as in the following example:**

   ```
   A:\xxxxx.img
   ```

   When the transfer begins, the Test LED stops flashing and remains lit. The following message is displayed:

   ```
   Download method established to be via:
   the serial port.

   Download in Progress....
   ```

   Downloading software through the serial port takes 5 to 10 minutes. When the download is complete, the switch automatically resets itself and comes up running the new software.

Note: When the switch resets, it loses any Telnet connections.

The final stage in downloading software is to verify that the new software was downloaded successfully. See "Verifying the Upgrade" on page 5-6.

TFTP Download

Before you begin a TFTP download, make sure the following conditions exist:

- An IP address is assigned to the switch (see “Assigning an IP Address” on page 4-7).
- A terminal is connected to the console port (see “Connecting a Terminal to the Console Port” on page 4-2).
- The switch has a data communication path to a TFTP server.
- The download file from the upgrade disk has been copied to an appropriate directory on the TFTP server.
- You know the IP address of the TFTP server and the file name to be downloaded.

To prepare for the TFTP download, you must enter the TFTP server IP address and the file name. To do so, follow these steps:

1. **Select System Configuration Menu from the Main Menu.**

   The System Configuration Menu is displayed.

2. **Select Download Configuration.**

   The Download Configuration Menu is displayed similar to Figure 5-1.

```
Access Control: READ/WRITE

     Download Configuration Menu

   >>Previous menu
     TFTP Server IP Address              xxx.xxx.xxx.xxx
     TFTP File Name                      b302_100.bin




 Use UP or DOWN arrow to choose an item, <Enter> to select that item.
 Return to the previous screen.
```

Figure 5-1. Download Configuration Menu

3. **Use the arrow keys to select TFTP Server IP Address and press [Enter].**
4. **At the prompt, enter the IP address in dotted-decimal notation.**
5. **Use the arrow keys to select TFTP File Name and press [Enter].**
6. **At the prompt, enter the file name of the file to be downloaded.**

Note: For a TFTP download, the path to the file must be included in its name. For example, if the upgrade file name is *switch.bin* and it resides at */usr/tftp* on the TFTP server, then you must enter */usr/tftp/switch.bin* for the TFTP file name.

7. **Return to the System Configuration Menu. Use the arrow keys to select Gateway IP Address and press [Enter].**

   This address specifies an IP gateway to reach the TFTP server.

8. **Enter the gateway IP address in dotted-decimal notation.**

The next stage in the TFTP download is to access the downloader. To do so, follow these steps:

1. **Return to the Main Menu and select Download Software.**
2. **Press [Enter].**

   The following message appears on the screen:

   ```
   ARE YOU SURE YOU WANT TO ENTER THE DOWNLOADER? YES or NO
   ```

3. **Select YES to invoke the downloader and press [Enter].**

   (NO returns you to the Main Menu.)

   The switch begins a reset sequence, and the following message is displayed at the top of the screen:

   ```
   Entering the Downloader
   ```

   After approximately 5 seconds, the following message is displayed and the Test LED flashes on and off:

   ```
   Trying to establish a download method...
   (Esc to abort)
   Attempting Both Serial and TFTP Downloads.
   ```

At this point , the switch is ready to receive the new software. You can stop the download process by pressing [Esc]. The download process stops and the following message appears:

```
The download was aborted or failed.

Press Esc to reset the unit. Any other key to re-enter the
downloader.
```

If you press [Esc] again, the switch goes through a reset. If you press any other key, the switch reenters the downloader.

If both the switch and the server have been properly configured and are physically attached, the software transfer begins as soon as you access the downloader. The Test LED stops flashing and stays lit, and the following message is displayed on the screen:

```
Download method established to be via:
TFTP

Download in Progress...
```

The TFTP download process takes approximately 5 to 10 seconds. When the download is complete, a success message is displayed. The switch resets itself and comes up running new software.

Note: When the switch resets, it loses any Telnet connections.

The final stage in downloading software is to verify that the new software was downloaded successfully. See “Verifying the Upgrade” next in this chapter.

Verifying the Upgrade

To verify that the new software has been correctly installed, access the switch console menus and check the software (SW) version number, located in the top right corner of all screens. This number should match the version number that appears on the upgrade disk.

Appendix A
Technical Specifications

This appendix contains specifications for the Model 2216T switch.

General Specifications

Compatibility with Industry and Protocol Standards

IEEE 802.1d Transparent Bridging Specifications (ISO/IEC 10038)

IEEE 802.3 CSMA/CD (ISO/IEC 8802-3)

IEEE 802.3i 10BASE-T (ISO/IEC 8802-3, clause 14)

IEEE 802.3u 100BASE-TX (ISO/IEC 8802-3, clause 25)

Data Rate

10 Mb/s Manchester encoded or 100 Mb/s 4B/5B encoded

Environmental Specifications

Operating temperature:	41° to 104° F (5° to 40° C)
Operating humidity:	85% maximum relative humidity, noncondensing
Operating altitude:	Up to 10,000 ft (3,050 m) maximum
Storage temperature:	–13° to 158° F (–25° to 70° C)
Storage humidity:	95% maximum relative humidity

Electromagnetic Emissions

Meets requirements of:

FCC Part 15, Subparts A and B, Class A

EN 55 022 (CISPR 22:1985), Class A

VCCI Class 1 ITE

Safety Agency Approvals

UL 1950

CSA 22.2 #950

IEC 950 / EN 60 950 (TUV)

Designed to meet UL94-V1 flammability requirements

Electrical Specifications

Maximum line current:	100 VAC to 115 VAC 225 VAC to 240 VAC	1.0A 0.5A
VA rating:	25 VA	
Power consumption:	60 Watts maximum	
Thermal rating:	200 BTU/hour	

Physical Specifications

Dimensions:	17.5 (W) by 1.75 (H) by 9.5 (D) in. 44.2 (W) by 4.5 (H) by 23.2 (D) cm
Weight:	10 lb 3.7 kg

Microprocessor

Type:	Intel i960, 64 bit
Speed:	33 MHz

Memory

Processor DRAM:	1 MB
Buffer pool:	2 MB
Flash memory:	1 MB

Port Specifications

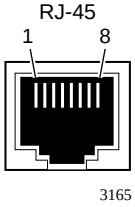
10BASE-T and 100BASE-TX Ports

These unshielded twisted-pair connections meet the requirements of ISO 8877, specified by 10BASE-T, Section 14, of the IEEE 802.3 specification.

Required cable:	Category 3 or 5 UTP (10BASE-T port) Category 5 UTP (100BASE-TX port)
Maximum length:	100 m

Table A-1 lists the pin assignments for the 10BASE-T and 100BASE-TX RJ-45 connectors. These connectors are wired as MDI-X.

Table A-1. RJ-45 connector pin assignments

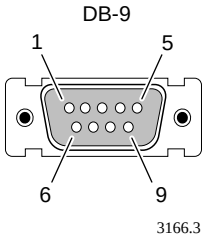
Connector	Pin no.	Signal
	1	RD+
	2	RD-
	3	TD+
	4	Not assigned
	5	Not assigned
	6	TD+
	7	Not assigned
	8	Not assigned

Console Port

Required cable: RS-232 serial

Table A-2 shows the pin assignments for the console port.

Table A-2. Console port pin assignments

Connector	Pin no.	Signal name*	Direction
	1	Not used	
	2	Transmit data, TD	To terminal
	3	Receive data, RD	From terminal
	4	Not used	
	5	Common signal ground	
	6	Not used	
	7	Not used	
	8	Not used	
	9	Not used	

* Other RS-232 signals such as DTR, CTS, and CD are not used.

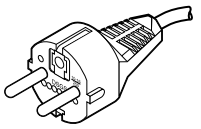
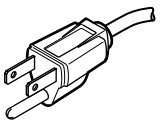
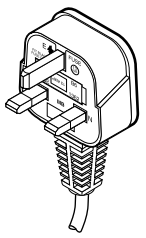
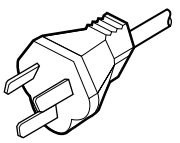
Power Cord Specifications

For installation in regions outside North America, replace the power cord with a cord approved by appropriate safety agencies. Any cord used must have a CEE-22 standard V female connector on one end and must meet the IEC 320-030 specifications.

Caution: Use only power cords with a grounding path. Without a proper ground, a person touching the unit is in danger of receiving an electrical shock. Lack of a grounding path to the unit may result in excessive conducted or radiated emissions.

Table A-3 lists specifications for international power cords.

Table A-3. International power cords

Country/Plug description	Specifications	Typical plug
Continental Europe: • CEE7 standard VII male plug • Harmonized cord (HAR marking on the outside of the cord jacket to comply with the CENELEC Harmonized Document HD-21)	220 or 230 VAC 50 Hz Single phase	 228FA
U.S./Canada/Japan: • NEMA5-15P male plug • UL recognized (UL stamped on cord jacket) • CSA certified (CSA label secured to the cord)	100 or 120 VAC 50–60 Hz Single phase	 227FA
United Kingdom: • BS1363 male plug with fuse • Harmonized cord	240 VAC 50 Hz Single phase	 229FA
Australia: • AS3112-1981 Male plug	240 VAC 50 Hz Single phase	 230FA

EC Declaration of Conformity

The product to which this declaration relates is in conformity with the following standards: EN50082-1:1992; EN55022:1987, Class A; EN 60950 A2/08.93; IEC801-2:1984; IEC801-3:1984; and IEC801-4:1988. It follows the provisions of Council Directive 89/336/EEC, as amended by Council Directive 92/31/EEC.

Appendix B
LEDs

This appendix describes the LEDs and their functions.

Figure B-1 shows the LEDs on the Model 2216T switch.

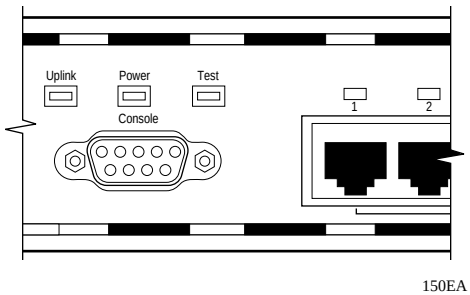


Figure B-1. LEDs on the Model 2216T switch

Table B-1 describes the meanings of the LEDs.

Table B-1. Meanings of Model 2216T Ethernet Switch LEDs

Label	Status/color	Meaning
Uplink	Green	During the power-up sequence, the 100BASE-TX port is going through its self-test. During normal switch operation, this port is properly connected, and data is being transmitted through the port.
	Off	The 100BASE-TX port is not connected, or no data is being transmitted through the port.
Power	Green	The switch is connected to power, and the power switch is turned on.
	Off	The switch is not connected to power, the power switch is not turned on, or there is a problem with either the power source or the power delivery system in the switch.
Test	Green	The switch is performing power-up diagnostic self-tests, or the switch has completed the diagnostics and failed one or more tests.
	Off	The switch has successfully completed the diagnostic self-tests, or the switch is not turned on.
1–16 (Port numbers)	Green	During the power-up sequence, the specified port is going through its self-test. During normal switch operation, the port is connected to an end station and data is being transmitted through the port.
	Off	The port is not connected to an end station, or data is not being transmitted through the port.

Note: The port LEDs light green only when traffic is present. During normal operation, the LEDs for connected ports may blink at different rates, depending on the amount of traffic on each port.

Appendix C
Sample Terminal Configurations

This appendix lists sample configurations for using terminal-emulation applications to connect to the Model 2216T switch through the console port. This appendix includes examples for the following applications:

- Windows 3.1 Terminal Manager
- Procomm Plus v2.01
- Windows 95

Windows 3.1 Terminal Manager

To use Windows 3.1 Terminal Manager, set the terminal for the following option and communications settings:

- Option settings:
  - — Terminal Emulation: DEC VT-100 (ANSI)
  - — Terminal Preferences: Terminal Modes
    - – Line Wrap: ON
    - – Sound: ON
    - – CR->CR/LF: No
    - – Use Function, Arrow, Ctrl Keys for Windows: No

- Communications:
  - 9600 baud
  - No parity
  - 8 bits
  - 1 stop
  - HW flow control
  - No Carrier Detect

Procomm Plus v2.01

To use Procomm Plus version 2.01, set the following terminal and protocol options:

- Terminal options
  - Terminal Emulation: ANSI
  - Duplex: FULL
  - Soft Flow Control: OFF
  - Hard Flow Control: ON
  - Line Wrap: ON
  - Screen Scroll: ON
  - CR Translation: CR
  - BS Translation: NON-DESTRUCTIVE
  - Break Length: 350
  - Enquiry: CIS B
  - ANSI 7 or 8 bit command: 7 bit

- ASCII protocol options
  - Echo Locally: NO
  - Expand Blank Lines: NO
  - Expand Tabs: YES
  - Clear pacing: 1 ms
  - Line pacing: 1
  - Pace character: 0
- Strip 8 bit: NO
  - ASCII download time-out: 10
  - CR translation (upload): NONE
  - LF translation (upload): NONE
  - CR translation (download): NONE
  - LF translation (download): NONE

Windows 95

To use Windows 95 terminal emulation, set the following hyperterminal settings:

- Properties
  - Bits per second: 9600
  - Data bits: 8
  - Parity: none
  - Stop bits: 1
  - Flow control: Xon/Xoff
- Settings
  - Emulation: VT100

Appendix D
Menus and Commands

This appendix describes the general structure of service port menus and illustrates all the service port menus for the Model 2216T switch. Tables in each section provide descriptions of all the commands and parameters.

Using Configuration Menus

When you have connected a terminal to the service port, or if you use Telnet to access the switch, you can access the switch configuration menus. The menus have a layout similar to the example shown in Figure D-1. The information is divided into the following parts:

- Menu or screen identification (menu title)
- A central screen area that contains a list of selectable items, either submenus to display or configurable parameters to set values for
- Navigation commands for the particular menu
- Command line and response for the selected item on the list (This area may include a range of values for the selected item.)

In general, to use a menu, you use arrow keys to highlight items on the screen and press [Enter] to invoke actions. For more details, see the instructions that follow.

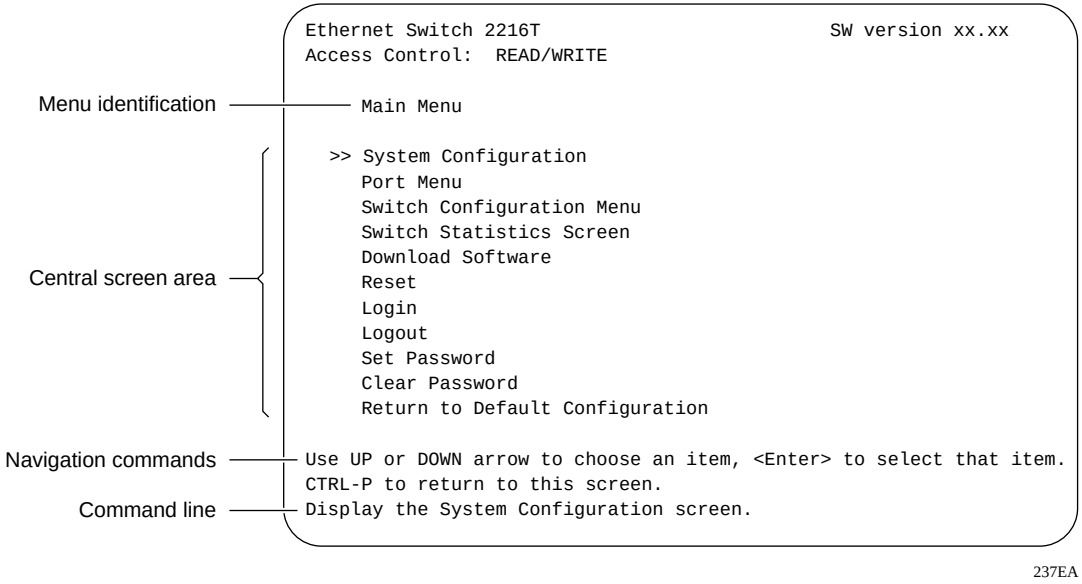


Figure D-1. Sample configuration menu

To use the configuration menus, follow these steps:

1. **Use the up and down arrow keys to choose an item from the list.**

   As you scroll through the list, “greater than” characters (>>) appear just to the left of the chosen item. At the same time, the command line at the bottom of the menu changes. For example, in Figure D-1, System Configuration is the chosen item, and the confirmation line reads “Display the System Configuration screen.”

2. **Press [Enter] to select the item.**

   If the selected item is a submenu title, the submenu is displayed when you press [Enter]. Again, use the arrow keys to choose items.

   If the selected item is a parameter, the confirmation line at the bottom of the screen changes and provides further choices. For example, some parameters display type-in fields when you select them. Others display the possible range of values at the bottom of the screen, and you must use the right and left arrow keys to select one.

3. **Press [Enter] to complete the action.**

   When you press [Enter], the value you have typed or chosen appears on the screen, or the menu you have selected is displayed.

At any time while you are using the configuration menus, you can press [Ctrl-P] to return to the Main Menu.

Factory Defaults

Table D-1 lists the factory default settings for the configuration parameters for the switch.

Table D-1. Factory default settings

Parameter	Default value
Password	NONE
Broadcast Cutoff Rate	100000
Terminal Baud Rate	9600
Bypass Extended Diagnostics	YES
Port Mirroring Enabled	NO
Port Number to Be Mirrored	2
Path Cost	100
Port Priority	128
Half or Full Duplex	Half Duplex
Active Aging Time	300
Purge Aging Time	620
Spanning Tree Protocol	OFF
Hello Time	2
Forward Delay	15
Max Age	20
Hold Time	1
Bridge Priority	32768

Menu Hierarchy

Figure D-2 shows the relationships among the configuration menus and commands.

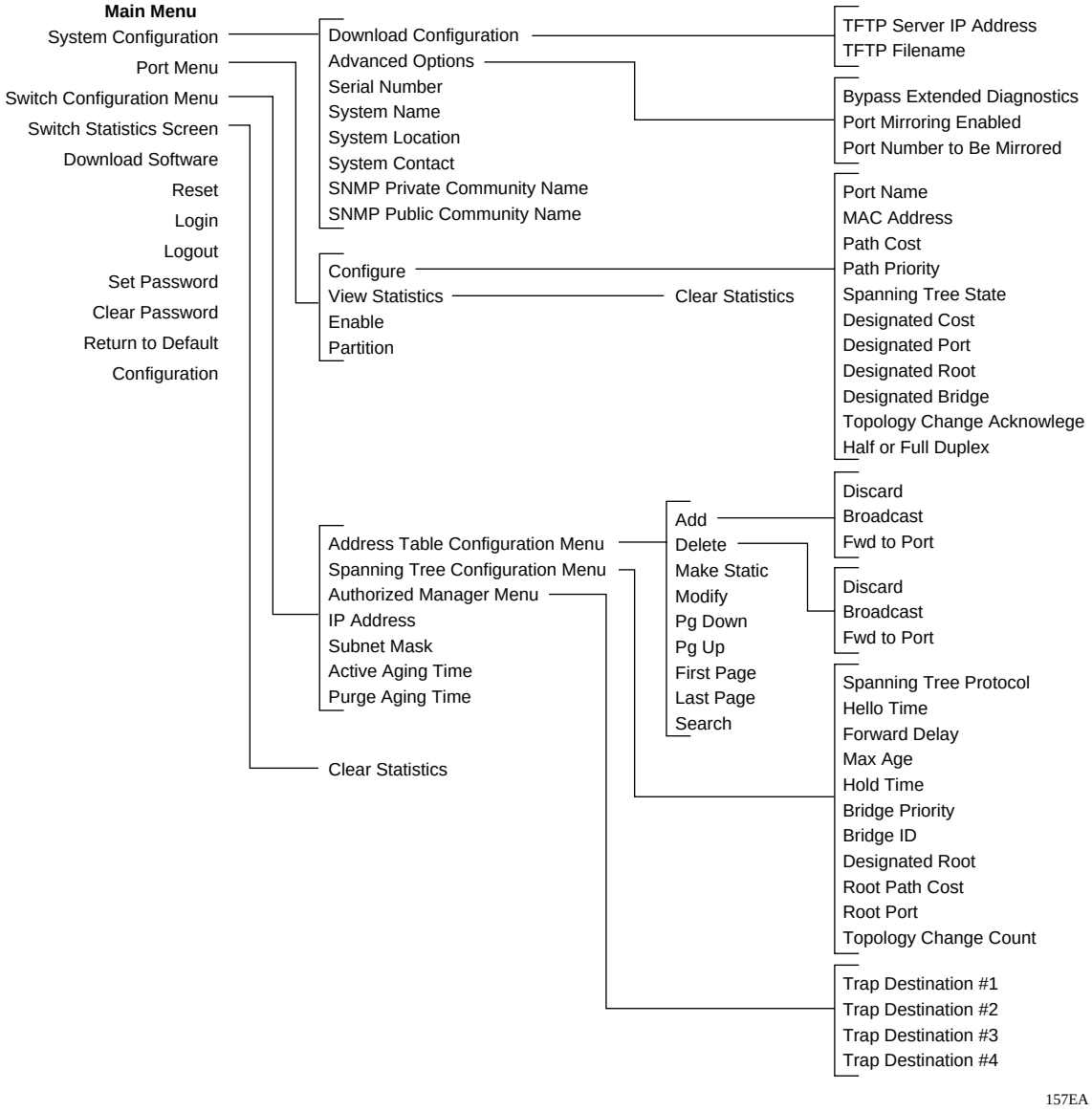


Figure D-2. Configuration menus and commands

Main Menu

When you press [Esc], the Main Menu is the first screen that is displayed (see Figure D-3).

```
Ethernet Switch 2216T                                SW version xx.xx
Access Control: READ/WRITE

      Main Menu

  >> System Configuration Menu
     Port Menu
     Switch Configuration Menu
     Switch Statistics Screen
     Download Software
     Reset
     Login
     Logout
     Set Password
     Clear Password
     Return To Default Configuration

Use UP or DOWN arrow to choose an item, <Enter> to select that item.
  CTRL-P to return to this menu.
  Display the System Configuration Menu.
```

Figure D-3. Main Menu

The commands listed in Table D-2 are available on the Main Menu.

Table D-2. Commands on the Main Menu

Command	Function
System Configuration Menu	Use this command to display the System Configuration Menu. This screen contains commands and parameters that reflect the global operation of the switch. The System Configuration Menu is described on page D-7.
Port Menu	Use this command to display the Port Menu. This menu shows the configuration of the individual ports on the switch and allows you to modify some settings for the ports. The Port Menu is described on page D-12.
Switch Configuration Menu	Use this command to display the Switch Configuration Menu. This menu provides access to other submenus allowing you to change configuration parameters that affect the switching operation of the switch. You can modify such parameters as the IP address, spanning tree parameters, and forwarding table information. The Switch Configuration Menu is described on page D-18.
Switch Statistics Screen	Use this command to display the Switch Statistics Screen, where you can view switch-level statistics in realtime. The Switch Statistics Screen is described on page D-25.
Download Software	Use this command to initiate a software download to the switch to upgrade the operating software. For downloading instructions, see Chapter 5, "Downloading Software."
Reset	Use this command to perform a software reset of the switch by reloading the operating software with all user-defined parameters.
Login	Use this command to log in to the console interface using a preset password.
Logout	Use this command to log out of the console interface. Once you log out, you must enter a password before you can access the interface again.
Set Password	Use this command to set the password for the console interface.
Clear Password	Use this command to clear the configured password for the console interface.
Return To Default Configuration	Use this command to set the switch operating parameters back to their factory-shipped, default settings. You must reset the switch to make these parameters take effect.

System Configuration Menu

To display this menu, select System Configuration Menu from the Main Menu. The System Configuration Menu is displayed similar to Figure D-4.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

     System Configuration Menu

    >>Previous Menu
      Download Configuration
      Advanced Options Menu
      Serial Number                  12739
      System Name
      System Location
      System Contact
      SNMP Private Community Name    private
      SNMP Public Community Name     public
      Powerup Count                  9
      Broadcast Cutoff Rate          100000
      Gateway IP Address
      Terminal Baud Rate             9600



  Use UP or DOWN arrow to choose an item, <Enter> to select that item.

  Return to the previous menu.
```

Figure D-4. System Configuration Menu

This menu contains commands for displaying submenus and fields for setting parameters that reflect the operation of the system as a whole.

Table D-3 lists the commands and fields on the System Configuration Menu.

Table D-3. Commands and fields on the System Configuration Menu

Command	Function
Previous Menu	Returns to the Main Menu.
Download Configuration	Use this command to display a screen from which you can specify the IP address and file name for downloading software. For downloading instructions, see Chapter 5, "Downloading Software."
Advanced Options Menu	Use this command to display the Advanced Options Menu. You can enable advanced diagnostics and port mirroring from this menu. For more information about the Advanced Options Menu, see page D-10.
Serial Number	This read-only field displays the serial number of the switch.
System Name	Use this field to enter an administrative name for the switch. The maximum length for this parameter is 16 characters. This parameter is used for SNMP management.
System Location	Use this field to enter the physical location of the switch. The maximum length for this parameter is 32 characters. This parameter is used for SNMP management.
System Contact	Use this field to enter the name of the contact person for the operation of the switch. The maximum length for this parameter is 32 characters. This parameter is used for SNMP management.
SNMP Private Community Name	Use this field to enter the community name for read/write SNMP access to the switch.
SNMP Public Community Name	Use this field to enter the community name for read-only SNMP access to the switch.
Powerup Count	This field displays the number of times the switch has been powered up or reset.
Broadcast Cutoff Rate	This parameter indicates the packets-per-second rate at which the switch starts dropping flood frames (broadcast or destination unknown frames) forwarded by the switch. The parameter is used to prevent broadcast storms and spanning tree problems. Possible values for this parameter are from 200 to 100000. The default is 100000.

Table D-3. Commands and fields on the System Configuration Menu (continued)

Command	Function
Gateway IP Address	The default gateway (or router) to which the switch sends IP packets destined for a different subnet. This address must be on the same IP subnet as the IP address set for the switch in the Switch Configuration Menu. The IP address is in dotted-decimal notation.
Terminal Baud Rate	Use this field to set the baud rate at which the console interface is operating. Possible choices are 2400, 9600, and 19200. The default is 9600.

Download Configuration Screen

To display this screen, select Download Configuration from the System Configuration Menu. A screen is displayed similar to Figure D-5.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

  Download Configuration

>>Previous Menu
  TFTP Server IP Address            xxx.xxx.xxx.xxx
  TFTP Filename                     b302_100.img



Use UP or DOWN arrow to choose an item, <Enter> to select that item.

Return to the previous menu
```

Figure D-5. Download Configuration screen

This screen allows you to enter the IP address of a TFTP server and a file name for downloading software.

Advanced Options Menu

To display this menu, select Advanced Options Menu from the System Configuration Menu. The Advanced Options Menu is displayed similar to Figure D-6.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

Advanced Options Menu

     Previous Menu
     Bypass Extended Diagnostics         YES
   >>Port Mirroring Enabled              NO
     Port Number to Be Mirrored



Use UP or DOWN arrow to choose an item, <Enter> to select that item.

  Yes = Enable port mirroring. No = Disable port mirroring.
```

Figure D-6. Advanced Options Menu

The commands listed in Table D-4 are available on the Advanced Options Menu.

Table D-4. Commands and parameters on the Advanced Options Menu

Command	Function
Previous Menu	Use this command to return to the Main Menu.
Bypass Extended Diagnostics	This command disables the extensive power-up diagnostics in the switch. The default value for this command is YES. For problem troubleshooting, set this command to NO to enable the extensive diagnostics.
Port Mirroring Enabled	Use this command to enable the port mirroring capabilities of the switch. Using port mirroring, traffic transmitted and received on any 10BASE-T port is mirrored to port 1. When port mirroring is enabled, port 1 ceases to be a switch port and instead mirrors the traffic on the port specified by the Port Number to Be Mirrored parameter. The port 1 LED blinks a certain number of times corresponding to the number of the port currently mirrored.
Port Number to Be Mirrored	Use this parameter to specify the number of the port with traffic currently mirroring to port 1. This value is meaningful only if the Port Mirroring Enabled value is YES. Enter a port number from 2 to 16. Port mirroring is not supported for the 100BASE-TX port.

Port Menu

To display this menu, select Port Menu from the Main Menu. The Port Menu is displayed similar to Figure D-7.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

     Port Menu

     Port#        Port Name          Type           Status
     1                               10BASE-T       NO LINK
     2          Accounting           10BASE-T       LINK
     3                               10BASE-T       NO LINK
     4          Engineering          10BASE-T       LINK
     5                               10BASE-T       NO LINK
     .          .                    .              .
     .          .                    .              .
     .          .                    .              .
     14                              10BASE-T       NO LINK
     15                              10BASE-T       NO LINK
     16         Sales                10BASE-T       LINK

   >> 17        Server1             100B-T/FD      LINK

  Use UP or DOWN arrow to choose a port.

Right or Left arrow to choose, <Enter> to select, <Esc> to abort
>>Prev. Menu     Configure     View Statistics     Enable     Partition
```

Figure D-7. Port Menu

This menu lists the ports on the switch, indicating the name (if one is recorded), network type, and current attachment status for each port. NO LINK indicates that the port is not connected to anything. LINK indicates that the port is connected and able to pass traffic. PARTITIONED indicates that the port is connected but has been partitioned.

To use this menu, highlight the number of the port to be configured using the up and down arrow keys. Then select one of the four commands at the bottom of the menu using the right and left arrow keys, and press [Enter]. Table D-5 lists the commands for the Port Menu.

Table D-5. Commands for the Port Menu

Command	Function
Prev. Menu	Use this command to return to the Main Menu.
Configure	Use this command to display the Switch Port Configuration Menu, which provides information about the selected port and allows you to configure certain port parameters. The Configure Port Screen is described in "Switch Port Configuration Menu" next in this appendix.
View Statistics	Use this command to display the Statistics for Port screen that shows traffic statistics for the corresponding port. This screen is described on page D-16.
Enable	Use this command to enable the selected port for operation in the switch. The switch is shipped with all ports enabled by default.
Disable	Use this command to disable the selected port from operation in the switch. Choosing this option changes the value in the port Status column to DISABLE.

Switch Port Configuration Menu

To display this menu, select Configure from the Port Menu. The Switch Port Configuration menu is displayed similar to Figure D-8.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Switch Port Configuration: Port #1:

     Previous Menu
   >>Port Name
     MAC Address                    00C0BA-037FB6
     Path Cost                      100
     Port Priority                  128
     Spanning Tree State            Forwarding
     Designated Cost                0
     Designated Port                0
     Designated Root
     Designated Bridge
     Topology Change Acknowledge    NO
     Half or Full Duplex            FULL



  UP or DOWN to choose, <Enter> to select. (Note: All Times Are In Seconds)

  Set the Port Name.
```

Figure D-8. Switch Port Configuration menu

The Switch Port Configuration menu provides read-only information about some parameters for the specified port and allows you to set the other parameters. This menu includes a display of the MAC address of the port, an assignable name for the port, and a number of spanning tree parameters for the port. In addition, this menu provides an option for setting the 100 Mb/s port for half- or full-duplex operation.

The spanning tree parameters for the port are established by the operation of the Spanning Tree Protocol in the switch. For more information about the spanning tree parameters, see Appendix E.

The parameters included on this menu are listed in Table D-6.

Table D-6. Parameters on the Switch Port Configuration menu

Parameter	Values
Previous Menu	Use this selection to return to the Main Menu.
Port Name	Use this parameter to set an administrative name for the port. The maximum length for this parameter is 15 characters.
MAC Address	This read-only field shows the 48-bit MAC address for the port in hexadecimal notation.
Path Cost	Use this parameter to set the path cost for the port. The range is 1 to 65535. The default is 100.
Port Priority	Use this parameter to set a priority for the port. The range is 0 to 255. The default is 128.
Spanning Tree State	This read-only field shows the state of the port, which describes how the port operates under the Spanning Tree Protocol. Possible states are Blocking, Listening, Learning, Forwarding, and Disabled.
Designated Cost	This read-only field shows the cost (or length) of the path to the root bridge.
Designated Root	This read-only field shows the unique Bridge Identifier of the root bridge for the network associated with this port.
Designated Bridge	This read-only field shows the unique Bridge Identifier of the designated bridge for the network associated with this port.
Topology Change Acknowledge	This read-only field shows whether or not the Topology Change Acknowledgment flag is set.
Half or Full Duplex	Use this parameter to set the 100 Mb/s port for half- or full-duplex operation. The default value for this parameter is Half Duplex.

Statistics for Port Screen

To display this screen, highlight a port number on the Port Menu and select View Statistics. A Statistics for Port screen is displayed similar to Figure D-9.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

       Statistics For Port 2: ACCOUNTING

       Statistic Name                                      Total (Frames)

       Frames Received                                     1708
       Bytes Received                                      413308
       Receive CRC Errors                                  0
       Receive Alignment Errors                            0
       Receive Lack of Resource Errors                     0
       Frames Transmitted                                  1464
       Bytes Transmitted                                   354288
       Transmit Single Collisions                          0
       Transmit Multiple Collisions                        0
       Transmit Excessive Collision Errors                 0
       Transmit Carrier Loss Errors                        0
       Transmit Queue Excess Length Errors                 0
       Transmit Device Underrun Errors                     0

   Right or Left arrow to choose, <Enter> to select, <Esc> to abort.
   >>Prev. Menu     Clear These Statistics
```

Figure D-9. Statistics for Port screen

This screen shows the statistics for a single port and allows you to clear the accumulated value and start over. The statistics are displayed in realtime. To clear the statistics and start over, select Clear These Statistics.

Table D-7 lists the port statistics and their meanings.

Table D-7. Port statistics

Statistic	Meaning
Frames Received	The number of legal Ethernet frames received by the switch, as defined by the IEEE 802.3 standard.
Bytes Received	The number of bytes received as legal Ethernet frames by the switch.
Receive CRC Errors	The number of packets received by the switch with cyclic redundancy check (CRC) errors. These packets are dropped.
Receive Alignment Errors	The number of packets received at the switch with alignment errors.
Receive Lack of Resource Errors	This statistic is the sum of two errors: • Frames discarded because of lack of CPU time to process them • Frames discarded because of receive FIFO overrun errors
Frames Transmitted	The number of legal Ethernet frames transmitted by the switch as defined by the IEEE 802.3 standard.
Bytes Transmitted	A function of the number of bytes received as legal frames.
Transmit Single Collisions	The total number of collisions detected on the individual segments by the switch.
Transmit Multiple Collisions	The range of the number of collisions experienced by a single packet. The range is from 2 to 15 collisions.
Transmit Excessive Collision Errors	The number of errors recorded in the excessive collision register of the switch; indicates more than 15 collisions.
Transmit Carrier Loss Errors	The sum of transmit carrier loss errors from the switch.
Transmit Queue Excess Length Errors	The number of frames discarded because of overloaded transmit queue.
Transmit Device Underrun Errors	The number of transmit device underrun errors reported by the switch.

Switch Configuration Menu

To display this menu, select Switch Configuration Menu from the Main Menu. The Switch Configuration Menu is displayed similar to Figure D-10.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Switch Configuration Menu


   >> Previous Menu
      Address Table Configuration Menu
      Spanning Tree Configuration Menu
      Authorized Manager Menu
      IP Address                    198.147.079.235
      Subnet Mask                   255.255.255.000
      Active Aging Time (Sec.)      300
      Purge Aging Time (Sec.)       620
      Switch Status                 ON



  Use UP or DOWN arrow to choose an item, <Enter> to select that item.

Return to the previous menu.
```

Figure D-10. Switch Configuration Menu

This menu allows you to set parameters that affect the switching operation of the switch. It includes the commands and parameters that are listed in Table D-8.

Table D-8. Commands and parameters on the Switch Configuration Menu

Command/parameter	Function
Previous Menu	Use this command to return to the Main Menu.
Address Table Configuration Menu	Use this command to display the Address Table Configuration Menu, which allows you to view and modify forwarding table entries for the switch. For more information about the Address Table Configuration Menu, see page D-20.
Spanning Tree Configuration Menu	Use this command to display the Spanning Tree Configuration Menu, which allows you to view and modify spanning tree parameters for the switch. For more information about the Spanning Tree Configuration Menu, see page D-22.
Authorized Manager Menu	Use this command to display the Authorized Manager Menu for configuring the IP addresses of SNMP management stations to which traps are directed.
IP Address	The IP address of the switch. Enter an IP address in dotted-decimal notation.
Subnet Mask	The IP subnet mask of the switch that corresponds to the assigned IP address.
Active Aging Time	The aging time in seconds for entries in the forwarding table of the switch. Addresses in the table are marked for purging when they have been in the table the number of seconds specified by this parameter. The range of values for this parameter is from 10 to 1000000. The default is 300.
Purge Aging Time	The purge aging time in seconds for entries in the forwarding table of the switch. Addresses marked for purging are removed from memory when this time is reached. This time should be greater than or equal to the active aging time. The range of values for this parameter is from 10 to 1000000. The default is 620.
Switch Status	The current operational status of the switch in forwarding packets. This value defaults to ON, but you can change the setting to OFF to disable the operation of the switch.

Address Table Configuration Menu

To display this menu, select Address Table Configuration Menu from the Switch Configuration Menu. The Address Table Configuration Menu is displayed similar to Figure D-11.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Address Table Configuration Menu

     Destination MAC Addr    Type      Disposition     Port #   Port Name

   >> 0000F4-111111          Static    Fwd To Port     7
      00C0BA-02C0BF          System    Local
      00C0BA-02C0C0          System    Local
      00C0BA-02C0C1          System    Local
      00C0BA-02C0C2          System    Local
      00C0BA-02C0C3          System    Local
      00C0BA-02C0C4          System    Local
      00C0BA-02C0C5          System    Local



  Use UP or DOWN arrow to choose an item

Right or Left arrow to choose, <Enter> to select, <Esc> to abort.
>>Prev. Menu     Add     Delete     Make Static     Modify     Pg Dwn
  Pg Up    First Pg     Last Pg      Search
```

Figure D-11. Address Table Configuration Menu

This menu allows you to view and modify the current addresses in the forwarding table of the switch. Destination MAC addresses, along with forwarding information about them, are listed in a table format. The Type field can have the following values:

- Static—A table entry manually configured by the network manager that remains in the table indefinitely unless the network manager removes it.

- Dynamic—An entry in the table that was learned by the switch and that can be removed if the address is inactive on the network long enough. The Active Aging Time and Purge Aging Time parameters on the Switch Configuration Menu determine when a dynamic entry is removed. Dynamic entries are made Static by using the Make Static option.
- System—An entry for an address that is recognized to be destined for the switch itself. It is read in and processed by the switch. System entries cannot be changed.

The Disposition field indicates the type of action taken by the switch when a packet with the associated destination MAC address enters the switch. The destination port can be modified or filtered to ensure security, to reduce traffic, or to isolate segments of the network. This field can have the following values:

- Fwd To Port—The switch forwards the packet to the port number indicated in the Port # field.
- Discard—The switch discards the packet.
- Local—The switch processes the packet locally.
- Broadcast—The switch sends the packet to all ports in the switch.

Table D-9 lists the commands available on this menu.

Table D-9. Commands on the Address Table Configuration Menu

Parameter	Values
Prev. Menu	Use this command to return to the Main Menu.
Add	Use this command to add an address to the table.
Delete	Use this command to delete the selected address from the table.
Make Static	Use this command to make the selected address static.
Modify	Use this command to change the disposition for the selected address.
Pg Dwn	Use this command to scroll down through the displayed list of addresses.
Pg Up	Use this command to scroll up through the displayed list of addresses.
First Pg	Use this command to display the first page of the list of addresses.
Last Pg	Use this command to display the last page of the list of addresses.
Search	Use this command to go directly to a specified address entry in the table. At the prompt, enter the address you want to go to.

Spanning Tree Configuration Menu

To display this menu, select Spanning Tree Configuration Menu from the Switch Configuration Menu. The Spanning Tree Configuration Menu is displayed similar to Figure D-12.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

      Spanning Tree Configuration Menu

                                Configured Value      Current Value

    >>Previous Menu
      Spanning Tree Protocol    OFF
      Hello Time                2                     2
      Forward Delay             15                    15
      Max Age                   20                    20
      Hold Time                 1
      Bridge Priority           32768
      Bridge ID                                       8000-00C0BA037FB7
      Designated Root                                 8000-00C0BA037FB7
      Root Path Cost                                  0
      Root Port                                       NO PORT
      Topology Change Count                           0


  UP or DOWN choose, <Enter> to select. (Note: All Times Are In Seconds)

  Return to the previous menu.
```

Figure D-12. Spanning Tree Configuration Menu

The Spanning Tree Configuration Menu allows you to modify the parameters listed in Table D-10.

Caution: Read Appendix E, "Spanning Tree Concepts," before you change any settings for spanning tree parameters. You can cause serious network deterioration if you do not understand spanning tree concepts enough to configure the spanning tree parameters properly. Be very careful if you choose to turn on spanning tree operation.

Table D-10. Parameters in the Spanning Tree Configuration Menu

Parameter	Values
Previous Menu	Use this selection to return to the Main Menu.
Spanning Tree Protocol	Use this parameter to enable or disable the spanning tree operation in the switch. The default value for this parameter is OFF. You must set this parameter to ON before you can modify the other spanning tree parameters.
Hello Time	The time interval between transmission of configuration Bridge Protocol Data Units by a bridge that is attempting to become the root bridge or is the root bridge. The range of values for this parameter is from 1 to 10. The default is 2.
Forward Delay	The time in seconds that a port spends in one of the transitory states (Listening or Learning) while it moves from the Blocking state to the Learning state or from the Listening state to the Forwarding state. The range of values for this parameter is from 4 to 30. The default is 15.
Max Age	The maximum time that a bridge keeps any received Bridge Protocol Data Unit. The range of values for this parameter is from 6 to 40. The default is 20.
Hold Time	The minimum time between transmission of any two Bridge Protocol Data Units through a port. The range of values for this parameter is from 1 to 360. The default is 1.
Bridge Priority	A 2-byte value that is combined with the MAC address to form the bridge identifier or bridge ID. The range of values for this parameter is from 0 to 65535. The default is 32768.
Bridge ID	An 8-byte value that is composed of the 6-byte MAC address and the 2-byte bridge priority.
Designated Root	The bridge ID for the bridge assumed to be the root bridge.
Root Path Cost	The cost of the path from this bridge to the root bridge. It is equal to the sum of the Designated Cost and Path Cost parameters for the root port. If this bridge is the root bridge, the value of this parameter is zero.
Root Port	The port identifier for the port that is closest to the root bridge, that is, the port with the lowest cost path to the root bridge.
Topology Change Count	The number of times a change to the active network topology has been detected.

Authorized Manager Menu

To display this menu, select Authorized Manager Menu from the Switch Configuration Menu. The Authorized Manager Menu is displayed similar to Figure D-13.

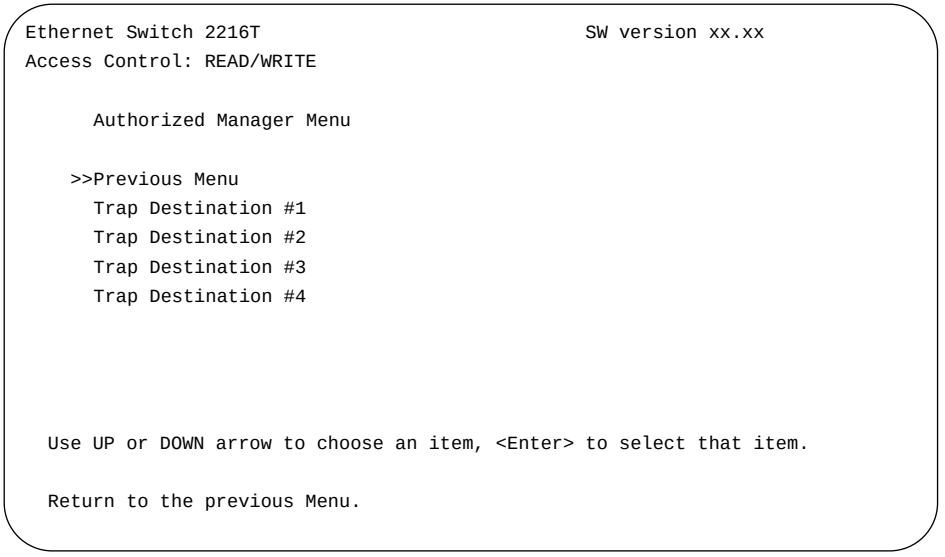

Ethernet Switch 2216T SW version xx.xx
Access Control: READ/WRITE
Authorized Manager Menu
>>Previous Menu
Trap Destination #1
Trap Destination #2
Trap Destination #3
Trap Destination #4
Use UP or DOWN arrow to choose an item, <Enter> to select that item.
Return to the previous Menu.

Figure D-13. Authorized Manager Menu

This menu allows you to specify the management station where SNMP traps will be sent. For each management station, enter an IP address for SNMP traps.

Switch Statistics Screen

To display this screen, select Switch Statistics from the Main Menu. The Switch Statistics Screen is displayed similar to Figure D-14.

```
Ethernet Switch 2216T                              SW version xx.xx
Access Control: READ/WRITE

   Switch Statistics Screen

   Statistic Name                          Total (Frames)   Rate (Frames/Sec)

  >>Frames Received                        0                0
    Frames Filtered                        0                0
    Frames Forwarded                       0                0
    Frames Dropped                         0                0



Right or Left arrow to choose, <Enter> to select, <Esc> to abort.
>>Prev. menu      Clear These Statistics
```

Figure D-14. Switch Statistics Screen

This screen displays cumulative counts for all ports on the switch. To clear the statistics and start over, select Clear These Statistics.

This screen includes the statistics listed in Table D-11.

Table D-11. Switch statistics

Statistic	Definition
Frames Received	The total of all the frames received on all the ports.
Frames Filtered	The total of all the frames filtered (not forwarded) on all the ports.
Frames Forwarded	The total of all the frames forwarded at all the ports; should be close (but not exactly equal) to number of frames received minus number of frames filtered.
Frames Dropped	The sum of all error counts that cause a frame to be discarded.

Appendix E
Spanning Tree Concepts

The IEEE 802.1d Spanning Tree Protocol resolves the problem of loops in the network by establishing only one *primary* path between any two switches in a complex network, as shown in Figure E-1. Any duplicate paths are barred from use and become standby or blocked paths until the original path fails, at which point they can be brought into service.

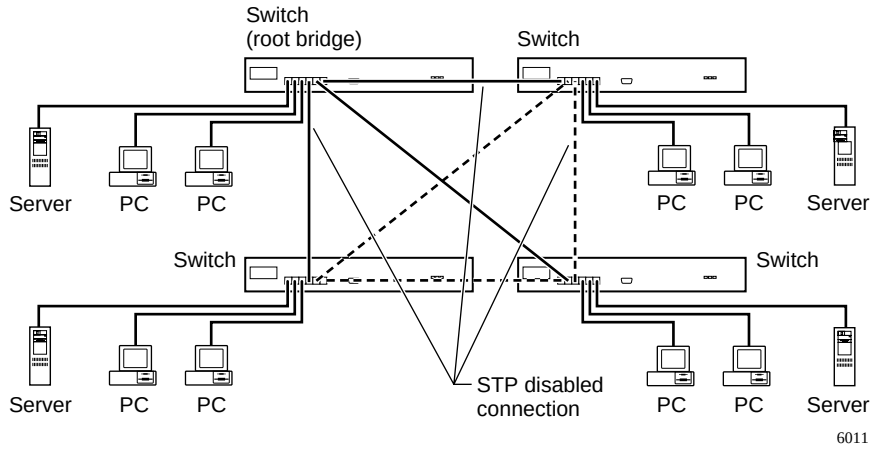


Figure E-1. Spanning Tree Protocol (STP) in a network

Spanning Tree Features

The Model 2216T switch meets the requirements of the Spanning Tree Algorithm by performing the following functions:

- Create a single spanning tree from any arrangement of bridging or switching elements.
- Compensate automatically for the failure, removal, or addition of any bridge in an active data path.
- Achieve port changes in short time intervals, which establishes a stable active topology quickly with a minimum of network disturbance.
- Use a minimum amount of communications bandwidth to accomplish the operation of the Spanning Tree Protocol.
- Reconfigure the active topology in a manner that is transparent to stations transmitting and receiving data packets.
- Manage the topology in a consistent and reproducible manner through the use of Spanning Tree Protocol parameters.

Spanning Tree Protocol Parameters

Several configuration parameters control Spanning Tree Protocol operation. Table E-1 describes these and lists switch default settings for each parameter.

Caution: You can cause serious network deterioration if you do not understand spanning tree concepts enough to configure the spanning tree parameters properly. Be very careful if you choose to turn on spanning tree operation.

Table E-1. Spanning Tree Protocol defaults

Parameter	Description	Default value
Bridge Group Address	Unique MAC group address, recognized by all bridges in the network.	
Bridge Identifier	Identifier for each bridge, consisting of two parts: a 16-bit bridge priority and a 48-bit network adapter address. Ports are numbered in absolute numbers from 1 through 8 regardless of their bridge attachment. The network adapter address is the same address as the first port of the bridge.	32768 (bridge priority)
Port Identifier	Identifies each port of each bridge.	Port 1: 32768
		Port 2: 32769
		Port 3: 32770
		Port 4: 32771
		Port 5: 32772
		Port 6: 32773
		Port 7: 32774
		Port 8: 32775
		Port 9: 32776
		Port 10: 32777
		Port 11: 32778
		Port 12: 32779
		Port 13: 32780
		Port 14: 32781
		Port 15: 32782
		Port 16: 32783
Port Priority		128
Cost Components of each port	The Spanning Tree Protocol calculates and ensures that an active topology generates minimal cost paths. The value 100 is generally used for 10 Mb/s Ethernet networks.	100

For detailed information on the operation of the Spanning Tree Algorithm, consult Section 4 of IEEE Std 802.1d, ISO/IEC 10038: 1993.

Spanning Tree Protocol Operation

When the Spanning Tree Protocol is enabled for the first time or when there is a change in the network topology, such as a failure or the addition or removal of a component, the Spanning Tree Protocol automatically sets up the active topology of the current network.

Communicating Between Bridges

Periodically, all devices running Spanning Tree Protocol on a network transmit packets to one another “in care of” the bridge group address that all bridges share. When a bridge receives a frame sent to the bridge group address, the bridge’s Spanning Tree Protocol processes the packet, which is ignored by application software and other LAN segments. Bridges communicate in order to determine the root bridge.

Selecting a Root Bridge and Designated Bridges

During communication among bridges, one bridge is determined to have the lowest bridge identifier. This bridge becomes the root bridge.

After the root bridge is selected, each LAN segment looks for the bridge with the lowest cost relative to the root bridge. These bridges become designated bridges.

Selecting Designated Ports

Each designated bridge selects a designated port. This port is responsible for forwarding packets to the root bridge.

Handling Duplicate Paths

When the active topology of the network is determined, all packets between any two nodes in the network use only one path. Where a duplicate path exists, the nondesignated port is put into a blocking state.

Remapping Network Topology

If a change in the network topology occurs because of a failure or the removal or addition of any active components, the active topology also changes. This topology change could trigger a change in the state of some blocked ports.

The blocked ports do not forward packets immediately. They first pass through two states—Listening and Learning—to verify that they may commence forwarding. A port remains in each of these two states for the time defined by the Forward Delay parameter. This algorithm ensures that no temporary loops exist in the active network topology and functions as a safeguard against packet forwarding during a network topology change period.

Appendix F
MIB Support

This appendix contains information about the management information base (MIB) objects associated with the Model 2216T switch.

MIB Objects

A number of different MIB specifications have been defined for managing network equipment, some standard and some proprietary. SNMP-compliant devices typically support one or more standard MIBs defined by the Internet Engineering Task Force (IETF), in the form of Request for Comments (RFC) documents. These MIBs provide a common method of managing devices such as bridges and hubs, and managing network interfaces such as Ethernet and token ring. The main standard MIB, referred to as MIB-II, provides an overall view of the managed agent and is supported, at least in part, by all SNMP agents.
In addition, proprietary MIB extensions are defined by commercial vendors for managing device-specific functions of their products. These extensions contain information that does not fit into any standard RFC specification. The private extensions allow specific port, bridge, and system-level operations to be controlled and monitored on the switch.

The switch supports the following three standard MIBs:

- RFC 1213—Management Information Base for Network Management of TCP/IP-based Internets (MIB-II)

  Provides management of switch system-level parameters, including TCP/IP protocol-related statistics, IP addressing, routing table information, and interface statistics for each switch port.

- RFC 1398—Definitions of Managed Objects for the Ethernet-like Interface Types (Ethernet MIB)

  Provides management and monitoring for the Ethernet-specific aspects of each port on the switch.

- RFC 1493—Definitions of Managed Objects for Bridges (Bridge MIB)

  Provides management for the bridge aspects of the switch, including the Spanning Tree Protocol.

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